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JACK'S EDUCATION

OR

HOW HE LEARNT FARMING.

Professor HENRY TANNER, F.C.S.



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BY

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DEPARTMENT OF SCIENCE.



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PREFACE.

THE following papers have been prepared for the purpose of showing the manner in which the Science Classes, under the Government Department of Science, enable a youth to prepare himself for the Government Scholarships, and by a tolerably complete course of Science instruction qualify him for learning any industrial occupation with a thoroughly intelligent mind. Advantage has been taken of the opportunity, to show that such instruction may be made to diffuse itself beyond the youths thus taught, so as to be of direct advantage to many who are apt to consider themselves so well informed, as to be above all necessity for knowing the why and the wherefore involved in their daily duties.

The instruction in science given in Colleges has been reviewed from the stand-point of practical requirements, and with special regard to such a

course of study being rendered most valuable as a preparation for learning any commercial industry.

With a view of giving an insight into the most desirable mode of subsequently learning the practice of agriculture, the experiences of a farm-pupil have been given, so as to show some of the deficiencies which are observable when an individual has learnt only one-half of his business. In the present instance, however, a good knowledge of science is made the foundation for a thoroughly sound acquaintance with agricultural practice.

LONDON, *September*, 1879.

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JACK'S EDUCATION;

OR,

HOW HE LEARNT FARMING.

CHAPTER I.

AN IMPORTANT DECISION.

JACK had now made such progress at his studies that Holmes thought he might fairly leave school and help on the farm. Here also he gave his father satisfaction, and when the harvest work was over Holmes promised his son to reward him. No definite form of reward being named, and Jack, being already of opinion that a distinct understanding was better than a vague promise, resolved that it should take a settled form as soon as possible. Striking the iron whilst it was hot, Jack proposed that his father should let him attend some lectures upon agricultural science, which Mr. Nicholson was going to give in the neighbouring town of Wrexborough. Under the circumstances the required consent was given, but Holmes expressed great doubt whether Jack would gain anything from book-farming of that sort. Jack, with all the ardour of youth, resolved to master the work, whilst Holmes watched with interest for the time when Jack would give it up as rather a heavy job. The only change he observed was that Jack's walk made him eat his supper with a better appetite, and thus he had one consolation for the hard nuts Mr. Nicholson gave him to crack, but the decision at which Jack had arrived involved interests of infinitely higher importance

than these, for his future career in life was largely determined thereby.

It was not long after the lectures had commenced when Jack was noticed to smile more than usual over his supper, and Mrs. Holmes naturally inquired what he was so merry about. Jack was bound to confess that he thought Mr. Nicholson had been for a walk in that neighbourhood, for he had said in his lecture that, happening to pass not ten miles from the Great Willow Tree, by Mr. Holmes' duck pond, he saw something which reminded him about tea. "Well," said Mrs. Holmes, "it could not be near here, at any rate, for I cannot see what Farmer Holmes has to do with tea." Jack, however, went on to tell Mr. Nicholson's tale, that when tea was first brought to England, the people, not knowing how to use it, stewed the tea, then poured away the liquor, and tried to eat the leaves with pepper and salt. "But how could they be so stupid?" said Mrs. Holmes; and, addressing her husband, she inquired "whether he really believed they did not know better than that." Much to her surprise, Holmes said "there was no limit to the stupidity of some people, but he thought they ought to have known better." Jack, knowing the remainder of Mr. Nicholson's tale, enjoyed the fun, and he went on to report that Mr. Nicholson said "what reminded him about the tea was seeing that strong black liquor had been running from the farmyard into the pond, and the dry and dusty manure was being carted to the land, to have the pepper and salt put upon it when it got to the field." This entirely altered the aspect of affairs, and it was not improved by Mrs. Holmes' suggestion that Holmes was the man who had been wasting the good tea and taking care of the leaves only. Jack, in his desire to save his father, reminded them that Mr. Nicholson said it was not ten miles from their Great Willow Tree. The defence did not answer, for Mrs. Holmes returned to the charge by saying they did not live ten miles from that Great Willow Tree outside. Holmes thought it more prudent to be silent, for he felt that he was the

sinner, and he quietly admitted the truth of the charge. As he was smoking, he appeared to think only of his pipe and to be watching the smoke as it travelled up the chimney.

Holmes, however, thought it prudent to change the subject, and inquired what Mr. Nicholson thought of the tree, for it had a great local fame. This, however, only led him deeper into the difficulty, for Mr. Nicholson had said "that the tree was very fine, and showed remarkably good feeding; but for his part he would rather feed the wheat in the field, which would bring money to the Bank, than feed any tree, however fine it might be." "But," inquired Holmes, "did he mean to say that that tree lives on the same stuff as wheat does?" Jack had no hesitation in saying he did, and "that the stuff that tree had lived upon would have made a bigger weight of wheat than of timber." He also said that "the money from ever so many tons of wheat lying at the Bank was never likely to be of much trouble, and that the tree would have done quite well enough upon water diet, without so much strong tea being wasted upon it."

Unfortunately for Holmes, he had had that day to refuse his wife some money for shopping, for he was rather short for the rent audit, which was coming the following week. His defenceless position did not spare him from his wife's inquiries, such as—How many tons of timber might there be in the tree? What was about the value of a ton of wheat? How much money might he have had now, if he had not thus wasted it. Holmes at last, having somewhat freely expressed his very best wishes for Mr. Nicholson for having got him into such a difficulty, finished his pipe abruptly, and went to bed.

Next time Jack had to go to his lecture, Holmes quietly told him, as he started, that he would come and meet him on the road home, and hear what had been said, for it would not do to have another such a disputation. But it soon became evident that Holmes had yet another lesson to learn. Surely 17 years or more

of wedded life should have already taught him that no such plan would prevent his wife satisfying her inquiring mind when once she thought she saw why there was so little money in the Bank, and why the Great Willow Tree flourished so gaily.

CHAPTER II.

HOME INFLUENCE.

THE time for Jack's return from Wrexborough was approaching, and Holmes remarked that he must go out and look at the sheep which had lately been put upon the turnips. His wife took her needlework and sat by the window. The sun was just about to set, and lighted up with brilliancy the now golden foliage of the Great Willow Tree. A bright and glorious sight indeed it was, and often had she enjoyed it, but to her all its beauty was now lost in one thought which its golden appearance suggested to her mind. "Would that that gold had been in the Bank, instead of being in the Great Willow Tree," burst from her lips, and she proceeded with her work thoughtfully. She was aroused after a time by Jack's return, and not long after Holmes joined the party.

Jack's evening meal, which awaited his return, was soon placed before him, and Mrs. Holmes seated herself near him, hoping Jack had something new to tell. His mother could not long stand his nervous hesitation, and boldly inquired what Mr. Nicholson had been lecturing about. It happened that he had been showing what bad management it was to keep cattle in the farmyard during the winter months—the farmer contenting himself if they were no worse at the end of the time than when taken from the fields. But Mr. Nicholson had said that many did not even do thus much, but allowed the cattle to lose the flesh they had put on during the previous summer, and he compared this to treadmill work, where there was much labour of walking without any progress, and yet if the person stopped walking he soon came

to grief. Jack, however, acknowledged that he did not know what this treadmill work was, and he was by no means satisfied when Holmes and his wife both expressed sincere hopes that he never might.

Holmes, however, here reminded Jack that Mr. Nicholson had said "that linseed cake was very expensive to buy and did not pay for using, unless—" "But how do you know what he said?" demanded Mrs. Holmes. A moment's hesitation was followed by Holmes admitting that "he went to meet the boy, as he thought the sheep were all right." The mother's expressive look needed no words to tell Holmes how fully she understood his sudden change of mind. Silence was again broken by Mrs. Holmes, who demanded, "Unless what?" "Unless you take care of the manure, and keep the goodness in it," said Jack. This Mrs. Holmes reminded her husband meant that you must not pour away the good tea, and keep the leaves for using with pepper and salt. "Holmes," she continued, "when you went to meet the lad, I sat in the window with my work, and when I saw the Great Willow Tree looking like so much gold, I could not help saying I wish that gold had been in the Bank instead of being in the tree. I shall never look on that tree again with pleasure." "Well, mother," said Holmes, "I tell you what I will do, we have both learnt a lesson, and we will soon have the water of that duck pond so clean that Mr. Nicholson may come and wash in it if he likes. You will now, I hope, look on the tree with your accustomed pleasure, and see there a golden promise for the time to come." The promise so cheerfully given, made each of the three happier, and Jack was now examined with the hope of finding some new source of profit—rather than of censure for the past.

Jack—no longer fearful of the consequences—reported some more of Mr. Nicholson's lecture, in which he had said that if they kept cattle "they ought to be doing something for the good of the farmer—making meat or milk, or growing into good stock;

and that science showed that you could not keep an animal alive and well without using food to do so, any more than you could keep a steam-engine in motion without water and coal to make the steam by which the engine was moved." He also said "that people were not in the habit of keeping a steam-engine in motion without making it do some profitable work; but farmers too often kept their stock alive without giving them food enough to let them make progress, and this was very much like keeping a steam-engine in motion but giving it no work to do."

The quiet discussion upon this statement ended in Holmes admitting, "After all, Jack, I really think there is something in science, and I have half a mind to start a bit earlier next time I go to meet you, and maybe Mr. Nicholson won't mind my sitting down in the room for a bit, if he has not quite finished when I get there. Just say so to him, Jack, with my respects."

CHAPTER III.

A RACE FOR LIFE.

A FRIENDLY nod of recognition from Mr. Nicholson satisfied Holmes as he entered the lecture-room that he was welcome; he therefore soon felt quite at home in the party, and at once became an attentive listener. The subject that evening was the growth of root crops, and the lecturer was just noticing the practice of giving swede turnips some very active manure to push them quickly into rough leaf, so as to save them from the fly. He said "that although it was a general practice, still he thought it was open to serious objection, and suggested that it was rather like a man who had to drive a long journey starting from his door as hard as his horse could gallop." Holmes knew that to drive in this style would condemn a man as a lunatic, and was anxious to know whether the two acts were in any way alike. Mr. Nicholson went on to say "that the swede had much to do before its work was completed, and its hardest work—and for the farmer its best work—had to be done when most of the quick grown plants had spent nearly all their strength. They had gone so fast at first, and had kept up the pace so hard, that they left steady growing plants far behind, but the mildew had settled upon them, and they were so completely beaten, that their steady growing neighbours were passing them, forming hard and solid roots for the farmer's use. He ventured to suggest that more attention should be given to supply the turnip fly with something else to feed upon, instead of making the swedes begin life at the galloping pace he had described." Holmes was sharp enough to remember that he had seen something of the kind on his own

farm, and how he had been disappointed. More than one of his crops when thus treated had been scarcely worth feeding off, after they had promised a much better result.

Holmes thanked Mr. Nicholson for what he had heard, and was invited by him to come with his son whenever he liked to do so. On the homeward walk Holmes told Jack confidentially that he began to think better than he did of the "book farmers," as he termed them, adding significantly, "Why, Jack, if I pick up a few of these ideas I shall make my farm pay me better than it has done of late."

Time rolled on, and Jack had seldom gone alone to Wrexborough, or if he had he was bound to report all he could remember. Holmes had kept to his promise, and the duck pond satisfied his wife, whilst he was equally pleased to see a change in the manure in the farmyard. He knew little of science, but his experience satisfied his mind that he had got something better worth his using. The early joke of the tea was often told when a neighbour dropped in for a chat, and Holmes was gradually becoming quite an authority upon the subject of agricultural science.

The lectures were nearly finished when something was said by Mr. Nicholson which Holmes at once saw would enable him to have a joke at his wife's expense. Scarcely had the evening meal been commenced before Holmes told his wife that Mr. Nicholson had been talking about her part of the farming business. Astonished at his intrusion into domestic matters, she replied that "she did think he would have known better than that. What could he know about kitchen affairs? But what did he say, Holmes?" Obedient to the call, Holmes reported as closely as he could Mr. Nicholson's remarks, which were to this effect: "The farmer often suffers loss, which is beyond his control, and which depends more upon his wife than himself." "But how can he know anything about it?" says Mrs. Holmes; "he is neither a farmer nor a farmer's wife." "Well," continued Holmes, "he

said he went into a farmer's kitchen not long ago." "Then it was not here, that you may take my word for," interrupted Mrs. Holmes. "He didn't say it was," says Holmes; "but he said they happened to be salting some very nice pork at the time, and as they rubbed the salt in he saw the goodness coming out of the meat, and he saw that much had come out before, and he told the good woman that this couldn't be right. She would not believe him until he called for a cup of boiling water, and got something like the white of an egg from the juice. And then, he said, that having pulled this goodness out of the bacon, he supposed after a time she would toast a slice for her husband and give him an egg or two to balance the account again. Or may be she would give him some beans or some peas with it to rectify the matter in this way." "But," inquired Mrs. Holmes, "did he say that was why people took eggs and beans and peas with their bacon?" "Yes, that he did," continued Holmes, "for he told us that when we did these foolish things our appetites often taught us how to correct some of our errors." "But did he tell you, Holmes," interposed his wife, "how to prevent this waste?" "No," replied Holmes, "he didn't; but he said he thought he must take the ladies in hand next, for they had as much to learn as the men, and he thought his next course of lectures must be given to them." Mrs. Holmes nearly lost her breath with astonishment, but at length she recovered strength to say—"Jack, my boy, if he does, you must go, and bring me word all about it."

This furnished a nice joke against the ladies for some time, and many a hope was expressed that Mr. Nicholson would give some more lectures, for after all they were not so bad. Jack, however, took to himself a large share of the credit, for he said, "If I hadn't gone to the lectures they wouldn't have known anything about the matter, and now they all want to know more about science."

CHAPTER IV.

A SHEPHERD'S EXPERIENCE.

THE spring work on the farm made all hands busy, and it became Jack's duty to help the shepherd. George had been in charge of the sheep for many years, he knew his flock, and he knew the land. No one doubted that he attended well to his work, neither did he want experience. His flock were to him like so many of his own family, every face was familiar to his eye, and he watched them with that kind care which only a good shepherd feels. But his life was now to him a constant grief, for day by day he saw his ewes dropping, too many only to die, and few able to give a full supply of milk to their lambs.

"How can you account for it, George?" said Holmes; "for I don't suppose you are to blame, but we never had such bad luck."

"Well, master," said George; "for the life of me, I can't tell. I think of it by day, and I think of it by night, but I can't hit it. They began turnips early, for you know we took the ewes off the clover before we had gone over the whole of the 10-acre piece, and they have had as many turnips and swedes as ever they could eat. I have always taken care to give them a dry lair, and done all that mortal man can do, and yet they are doing as badly as sheep can do."

Holmes told George that others were in just the same trouble, and that, according to the newspapers, a gentleman over in Norfolk had been looking into the matter, and he seemed to come to the conclusion that the turnips and swedes had got too much water, and not enough sound food in them, but where

they had given the ewes some good hay, the sheep did much better.

"I wish, master," said George, "we had begun the hay earlier; we are bad enough now, but if we hadn't given the hay I don't know where the sheep would have been. It strikes me the swedes beant as proofy as they used to be."

"That is just my idea, George," remarked Holmes, "and yet I see some gentlemen were arguing about the value of a ton of swedes. It's no wonder they couldn't agree about it, for some swedes are a great deal better than others. In fact I saw some this season which I am sure in my own mind were three or four times as good food as ours, and I suppose if we reckon that out, George, our ewes have had to eat three or four times as much to get a proper meal. After all, then, if we had 10 tons an acre of right down good swedes, maybe they would be better feeding than 30 tons such as we had."

"But you know, master," said George, "we said in the winter the ewes never seemed to have had enough to eat, and yet they seemed as full as a well-blown bladder. I don't like to see them so loaded, it can't be good for them. I have heard say that nothing is so dear as when you get too much for your money, and you mind that Jack, for I am sure it is true. But when they talk about what swedes be worth a ton, I say if I could see the swedes I'd tell you somewhere about what they be worth, but they can't tell what they be worth without seeing them any more than they can tell what a horse is worth without seeing he."

"By the by, George, have you been across the clover in the 10-acre piece lately?" inquired Holmes, "I think we shall have a better cut there than usual, but it is not all alike though."

"Yes, master, I have been over it many times lately," replied George, "for this side of the field is the finest bit anywhere about the country. It is right good up to where we hurdled it for the ewes, and strikes me it has something to do with the ewes eating it down, for daresay you know they sheep like the heart best, and

you can't help them taking the best bits, and maybe that's why the clover gets so thin on the ground."

"Then your idea is that it helps to kill some of the clover," remarked Holmes, "and does none of it any good, for I suppose it cannot root itself so well in the ground."

"Bless you, master," said George, "you just go, and pull up a bit of clover from each piece and see for yourself. Jack and I've tried it two or three times."

Holmes went at once, and came to the conclusion that feeding the young clovers in the autumn prevented them rooting well, and if it does not root well it is only reasonable to suppose there is less chance for its making an early and a strong growth in the spring, even if some of the clover does not die in the winter. He determined, however, to watch it and see how it would go on; but very little watching was really necessary, for the weaker piece of clover was left more and more behind as the season advanced.

When the day's work was ended Jack said to his father, "I heard what you and George were talking about the swedes and turnips this morning, and after you were gone I was telling him what Mr. Nicholson said about growing them so very fast, and about giving the fly something else to eat which they liked better than swedes. George told me that Mr. Humphreys, of The Grange, sows some mustard seed amongst his turnips, and the fly seems to like it better than the swedes, and he gets a good plant."

After a little consideration of the matter it was decided that some mustard seed should be sown as a sort of experiment, and that Mr. Nicholson's suggestion about having the manure better spread through the land should be tried. Holmes explained to Jack that what he and every other farmer wanted, was to have these sort of things properly tried in their own neighbourhood, because what was best for one part of the country was frequently not the best for some other part; and as farmers knew this to be

so, they would not follow any new plans which had not been tried somewhere near their own farms.

Just at this time Dr. Whichcord, of Wrexborough, joined the party; and he was much interested in the subject they were talking over. He, however, pointed out that it appeared to him that not only was local information of this kind necessary, but the experiments, to be of any value, ought to be done under some regular management; that it need not cost any more to work under a good system than under a bad one; whilst by well-directed inquiries, simultaneously carried out, a fuller knowledge of facts, and good confirmatory evidence would be very generally gained. Holmes explained to the Doctor that Jack attended the course of lectures given in the previous winter by Mr. Nicholson, and that he had also gone several times himself, and he added,

"The result of some of Jack's reports has been to set them all thinking, for not only he, but Mrs. Holmes and many of their friends who had heard about these lectures, seemed quite as interested as Jack." Dr. Whichcord had not heard anything about the lectures, neither did he know Mr. Nicholson; but he hoped to know more of both, and possibly something could be done with his help to get some good and useful experiments tried in the neighbourhood another year.

"But," remarked the Doctor, "if you want this sort of thing to answer, you ought to have the sound judgment of an experienced farmer regulated by an acquaintance with science. Where do you think my patients would be if I knew nothing of science, and if their chance of recovery—nay often of life—depended upon a sort of rule of thumb practice, but for which I knew no other rule nor reason. Rely upon it you will find that farming gives as wide an opportunity for a thoughtful mind as any one of our professions. The fatal error has been to think and act as if science alone can guide us in a business which of all others needs experience in the everyday work of the farm. I wonder who would trust a ship to the best student of navigation unless he had

been to sea, and was perfectly acquainted with every portion of his ship and all her fittings? Neither would anyone trust his ship to a man who did not know the principles of navigation, however long his experience at sea. So I say to Jack do not mind the labour of working at Mr. Nicholson's lectures, think well about them, talk to others upon the subject, you will then feel your work at home a more pleasing occupation than ever, and you will certainly have a better chance of success when you become a farmer. I am not a farmer, but I see what progress has been made in it during the last few years. If you take the outlay made every year upon such a farm as this for manure alone, you must see how important it is to understand what you are doing in this way. You may then spend your money better, and it may be that as you more fully understand what you are about, you will get better results and not have to spend so much. I wish, Holmes, you would ask Mr. Nicholson out some day; I will drive over accidentally and make his acquaintance."

"That is just what I was thinking of doing," said Holmes, "for I have got into some bother about the analysis of some manure I bought, and I should like to talk it over with Mr. Nicholson, and I know some others who want to meet him. My wife's sister, too, is very anxious to see him, for she is indignant because he spoke of the ladies wanting science as much as the men, for she thinks it will spoil them for their domestic duties."

CHAPTER V.

A DISPUTED ACCOUNT.

MR. NICHOLSON accepted Holmes' invitation, and as his young friend, Charlie Robinson, was down from town spending a few days with him, it was agreed that both would go out and have some farming. An hour's walk brought them to Holmes' house, where a cordial welcome awaited them, and Mr. Nicholson at once told Holmes, "I have taken the liberty of bringing my friend, Charlie Robinson, with me, Mr. Holmes, hoping we may do a little farming; and as he is studying agricultural chemistry in one of the city colleges, I think he will enjoy it."

"Glad to see you, Mr. Robinson," said Holmes.

Mrs. Holmes quickly made her appearance, and was greatly interested in making Mr. Nicholson's acquaintance, whose name had already become quite familiar in her house. "I hope you had no difficulty in finding your road," she said; "for a stranger it is sometimes rather troublesome."

No difficulty, however, had arisen, and Mr. Nicholson told her "he had been out that way before, and as long as he kept the Great Willow Tree as his landmark his course was tolerably certain." He knew not how much force was embodied in his reply, for he was not aware that anything had transpired in that home which gave to his remark any special interest. Light refreshment being served, the party were soon prepared for their walk.

"Where is Jack?" inquired Mr. Nicholson.

"He is up in the field sowing swedes," said Holmes. "We shall go that way, if you like. We are going to try a sort of experiment

there, and I should like you to see what we are about. You remember talking in one of your lectures about the man driving from home at a gallop, instead of starting on a long journey at a fair pace. Well, it struck me there was something in it, and I am going to try some change in the manure. I lost such a lot of ewes and lambs this spring, that I am bound to do something; and if we are spoiling our turnips by the way we manure them, the sooner we find out our mistake the better for me. My swedes last season were ready too soon, and I was bound to feed them sharp because they would not keep. Some of them really began to rot before they were what we should consider full grown. So I took my ewes off the young clover earlier than I intended; but I fancy I have learnt a good thing by that, and I will show you this also. Here we are at the turnip field, and there is Jack helping at the drill."

"Well done, Jack, my boy," said Mr. Nicholson. "Glad to see you well, and working like a young Briton. How is the land working?"

"It seems to me going all right," said Jack; "but Tom, who looks to the drill, says we are not putting in manure enough; still the land is working first rate." With that, Jack followed the drill; and Holmes explained, "Putting this and that together, I thought that on one part of the field we had better sow most of the artificial broadcast over the ground, and just give the turnips a little phosphate mixed with ashes. A sort of light breakfast at starting, you know, hoping they will find refreshment on the road. There is some good farmyard manure ploughed in over most of the field, and I must say I never put out a better lot of dung upon the land. My wife says I have got to thank you for this, and some day I will tell you all about it; but I want to talk to you now about the phosphate, for I have got into a little bother about it.

"It happened that I bought some superphosphate before Christmas from some good makers, and they guaranteed it 28 per

cent. soluble; and they said if they could send it in for me at once they would give me my discount later on, just as if I got it from them in May. It did not matter to me, as there was a good shed for it to be kept in, and they were short of room, and so the superphosphate came. After hearing what you said in one of your lectures, I thought I would have the superphosphate analysed. I sent it to be examined about a month ago, but I am told it has not got the 28 per cent. soluble agreed for, and, in fact, not more than 23. I wrote to the makers, and told them this was not as they guaranteed, but they say the manure was 28 when sent, and the manure is just as good now although there is only 23; but I don't see this, and I think they ought to allow me the difference. Now what do you say?"

"I do not see any reason," said Mr. Nicholson, "why they may not be quite right, and that you are really none the worse for the strength being reduced to 23."

"They did say something about phosphates being reduced," added Holmes; "but I want to see the bill reduced, and not the phosphates. However, I have determined that I won't be done, so I have got some more superphosphate which analyses 28 properly, and I am going to put it by the side of the other, and finish the field with it beyond where the dung was put in. I shall of course put in more of the superphosphate where there is no dung, and see how it answers. Now, Mr. Nicholson, what do you say about it?"

"Of course," replied Mr. Nicholson, "as a man of business you want money's worth for the money you pay, and if you deal with a respectable firm it is far more to their interest for them to let you have what will answer your purpose than to sell you a manure which will disappoint you, because they would, in such case, soon lose you as a customer altogether. So we must commence fairly all round, and have some confidence in the men we deal with. If you don't do this, but are fearful that you will be cheated, you won't know what to do, or with whom to deal. I should say first

make up your mind that you are dealing with honourable men, whose interest it is that you should have a manure which shall answer your purpose, and then treat with them in a sound business-like manner."

"Good advice," says Holmes, "I quite admit it as far as it goes, but I have not yet got to the bottom of this job. I do not see what can take away the phosphate. If they are right in saying they sent me 28 per cent. soluble, and I have only got 23, what has become of the 5 per cent. which is missing? Now, Mr. Robinson, you are a bit of a chemist, I believe, and you are fresh from College lectures, what do you say?"

Robinson, being thus put upon his mettle, said that Professor Grimshaw had been lecturing lately on that very subject, and he explained it very simply by showing that tetra-hydric calcic diphosphate could under certain circumstances take the form of dihydric dicalcic diphosphate, and this accounted for the reduced superphosphate.

"That may be a very clear explanation to you, Mr. Robinson," replied Holmes, "but I cannot say I quite understand it. Now you know I am a plain speaking man, and I don't pretend to know the language in which you are talking. Is the English language too poor to find words to explain the matter?"

"The explanation is clear enough," said Robinson, "and I know that is the right answer, but for the life of me, I can't tell vou any more about it. These things can only be explained in proper chemical language."

"I am afraid," said Holmes, "until you can give some more distinct answer than this, very few farmers will be any the wiser for that explanation. However, Mr. Nicholson, I really should like to know something about this, which I can understand. If you want to establish my confidence you must let me use my judgment, for directly you blindfold me you cause me to doubt; and I may in this way have doubts on my mind when I ought to have the perfect confidence you are recommending to me. How-

ever, here comes Jack, so I suppose they have finished drilling, and now we will all walk homewards."

As soon as Jack had joined the party, Holmes resumed the subject, calling upon Mr. Nicholson to remove from his mind the mystery involved in this dispute between him and the manure manufacturers. This he did in the following manner:—

"Our reason for using superphosphate is to add to the land the phosphate which is necessary for forming bone in the animal. If phosphate did not exist in herbage, and in our crops, these would be imperfect as food, and the animals feeding upon them could not form the skeleton of the body. Because it is necessary for animal life, it has also been made equally necessary for vegetable life, and hence there must be a supply in the soil if the crop is to grow. This constant demand upon the soil causes, after a time, a shortness in the supply in the land, and we find it necessary to add some to the soil in the form of manure. But, in order that it may be useful, it must be dissolved in water, otherwise it cannot pass into the small water pipes which run through the plant. The old-fashioned plan of using bones gave the supply very slowly, and Liebig proposed a plan for making bones work more quickly. He advised farmers to add some strong acid to the bone, and in this way he got the bone in such a condition that much of it could be immediately dissolved in water. That which was so dissolved in the water is called soluble phosphate, and that is what my friend Robinson prefers to call tetra-hydric calcic diphosphate, but you know it as soluble phosphate, and so does every farmer and manure dealer in the country, so we will stick to this name. It does not matter how the superphosphate is made, you have only to add a proper quantity of tepid water and let it dissolve for a few hours, and all the soluble phosphate passes into the water. Chemists have arrangements for determining the quantity of soluble phosphate dissolved out of a sample. Your superphosphate very likely gave 28 per cent. before Christmas, but in May it gave only 23 per cent., so you see about one-sixth of it appears to have been lost.

You naturally suppose that this portion of it has been lost, but this is a mistake. That portion which is missing has simply changed its form, and by reason of that change of form it now requires more water and longer time to dissolve it. Chemists have said that when it has undergone this change it is of little value, but farmers tell a very different tale. Whether a certain quantity be soluble in a tumbler of water or in a gallon of water it is phosphate still, and is valuable as a manure. I think you ought to be told by your analytical chemist whether the missing portion of that which was guaranteed be in the manure or not, and if it be there, then pay your money like a man."

"I am right down glad," said Holmes, "to hear your remarks, Mr. Nicholson, for I have no doubt the manure is all right after all, and I hate to have a difference about a bill, especially with a good and respected firm. Then you think all the phosphate which has been properly prepared should be paid for, even when it appears to have thus become reduced in strength."

Mr. Nicholson went on to say, "I certainly think it is only fair and just, as between man and man, to do so. But I may tell you another fact about it which may lead you to see that you really gain by this change, and that is, you will find when you are using manure which dissolves in water very quickly, there is a risk in some soils of its making a great dash in the growth for a short time, and then you will find all has been used up or washed away; so do not forget, in giving your turnips their breakfast, this reduced phosphate will help to provide something which they can feed upon right up to the end of the journey. Because the quantity has been reduced, it has become customary to call the superphosphates which have gone back in strength "reduced superphosphates."

"Thank you, Mr. Nicholson," said Holmes. "Why, I think even Jack can understand that. Now what do you call the stuff it is turned into?"

"Well, I simply call it slowly soluble phosphate," replied Mr. Nicholson.

"And what do you call it, Mr. Robinson?" inquired Holmes.

"Oh, I call it dihydric dicalcic diphosphate," said Robinson.

"For pity's sake," said Holmes, "don't use such an out-of-the-way name again; there is a deal too much dying about it to please me. No wonder the sheep get into such a dying way. Now then, Mr. Nicholson, as we are getting near home, just do as the parsons do—say a few words in conclusion, to clench the nail you have been driving."

So the discussion upon the manure bill ended by Mr. Nicholson saying, "All I need further say is, we have got phosphate in three distinct stages; very soluble, as in superphosphate; slowly soluble, as in the reduced superphosphate; and very slowly soluble, as in bone and mineral phosphates. But each has its proper use, and you must put each to its proper use, just as you would avoid entering a heavy cart-horse for the Derby, however long his pedigree, or however great his value."

CHAPTER VI.

THE BREAD AND BUTTER DEBATE.

On the return of the party Mrs. Holmes received them by saying, "I am really glad you have got back, Holmes, and I am sure the gentlemen must be tired, but it seemed to me you never would get across the Barn-close; you stopped and stopped, as if debating on politics. Surely you have not been getting Mr. Nicholson in for a lecture in the open field; it would have been only fair to have got him to do it in the house, for my sister and her husband, Mr. Forbes, have come to tea, and Dr. Whichcord has also dropped in, and they would have been pleased to listen to it."

"Well," said Holmes, "I don't think you would have been interested in it, for it had nothing to do with your part of the business."

Mrs. Holmes silently resolved to owe her husband one, for so cleverly bringing her domestic matters at once to the front. Scarcely were the party seated at the table when Mrs. Forbes informed Mr. Nicholson that she understood he was going to lecture the ladies next winter, and that she wished to know what it was all to be about. The attack was too distinct to be evaded, and Mr. Nicholson sought cover from it by remarking, that any assistance he could render the ladies should be at their command, and he inquired if she saw any way in which he could be of service. Mrs. Forbes did not care to satisfy him fully, but said that, as a matter of fact, it appeared to her that science had no aid to render in domestic matters, and that he would be a venturesome man who dared to pass the threshold of the female domain.

"I must give you credit, Mrs. Holmes, for the splendid bread you have," said Dr. Whichcord; "and the butter is better than ever."

"Well, both are made at home, Doctor," said Mrs. Holmes, "and I believe I have at last got my butter nearly as good as it can be. If all is well, I shall take the prize at our local show next time, and as it is I am getting 1*d.* per lb. more this season than I have done before, although the market is not generally so good."

"But how do you account for that, Mrs. Holmes?" inquired Dr. Whichcord. "We medical men naturally proceed from effect to cause, on the persuasion that where an effect is observed there must be a cause, and we ought to be able to find it out. I often noticed your butter, and always found it wonderfully well made, but it had some very slight flavour about it which was rather peculiar."

"Well, Doctor, if the truth must be told, I think the cows got at some weeds in the field, which flavoured the milk, and that was how it arose," said Mrs. Holmes; "but it was always a trouble to me when I wanted to put the butter down in pots. The butter never seemed to keep as well as it ought; anyhow, I blamed Holmes for it, for I cannot look after the herbage the cows feed upon."

It was no new matter to Holmes, and he at once explained to Dr. Whichcord that it had been the case all the year round, and that it mattered not whether the cows were tied up in the sheds and fed there, or whether they were on the pasture, and he appealed to him, and also to Mr. Nicholson, whether this did not show the cause to be independent of the weeds. Both of these gentlemen agreed to acquit Holmes of the responsibility.

"But," inquired Mr. Nicholson, "how about the dairy? Is that well ventilated, and are the tins properly scalded?"

On the latter point Mrs. Holmes was satisfied that boiling water—right down boiling water—was never spared, for she knew the necessity of that, but she admitted she had only been able to

open her dairy window freely this spring and summer, whereas before she had to close it at times to keep out the smell from the pond.

"That is the cause," said the Doctor. "Don't you agree with me, Mr. Nicholson?"

"Yes," said Mr. Nicholson. "That appears to me very probable, for the effluvium arising from the pond, as I noticed it some eight months back, was very likely to flavour the cream; and I am sure Mrs. Holmes knows even better than I do how important it is to keep away from milk those little particles of decaying matter which are so frequently thrown off."

"Then do you think anything was thrown off from the pond?" inquired Mrs. Holmes.

"Very probably so," suggests Mr. Nicholson, "for you spoke of some smell arising from the pond, and you cannot suppose you smell nothing. There must be some matter thrown off to cause the smell, and especially an offensive smell; and this matter, which was capable of irritating your nose, might have some effect upon the cream."

Here Mr. Forbes joined in the discussion, and remarked—"I have had as much experience in dairy work as anyone, for we make a good deal of cheese; and one reason why no dairy should have a pipe or drain to carry away the slops and washings is because of the air coming up the pipe. Sour matters will cling to the sides of the pipe, and this will give the dairy a bad air, which injures both the butter and the cheese. If such a pipe or drain were allowed, it ought to be plugged; but still it is a very bad plan. I have no doubt the foul air coming from the pond has lost Mrs. Holmes many a pound in the sale of her butter."

"Well, Holmes," interposed his wife, "this looks like profit No. 2 from keeping the pond clean. Shall we call it a second golden leaf of promise?"

Enough had been said to raise the inquiry as to what was the profit No. 1. This necessitated the old tale being told once more, and much to Mr. Nicholson's amusement. Nor was it without much

encouragement to him as well, for he thus saw a result from his work which he had never looked for, and he knew that the seed he had sown was springing up into a harvest which he had never anticipated.

Jack reminded his mother that she had given him some tea instead of his usual allowance of bread and milk, but she explained that the milk was just on the turn from the hot weather, and so he could not have it. On Mr. Nicholson's suggestion, a few grains of carbonate of soda were added to some milk before it was boiled, and Jack's bread and milk was soon brought in as good as usual, much to the surprise of all. Mrs. Forbes was not content with being surprised, and inquired how this prevented the milk turning; to which Mr. Nicholson quietly replied that he had heard it said that "he would be a venturesome man who dared to pass the threshold of the female domain;" adding, somewhat humorously, "What good can chemistry do in domestic matters?"

Mrs. Forbes bowed in acknowledgment of the shot, whilst Dr. Whichcord laughingly said,

"Well, Mrs. Forbes, that scores one for chemistry, anyhow."

"Yes," replied Mrs. Forbes, "I must admit it does; so now, Mr. Nicholson, do please explain the matter."

He did so by showing that fresh milk always contained some soda, but as the milk became changed some milk acid was formed, and this made a sort of flirtation with the soda, so that the soda could no longer do her proper work; but by putting some more soda into the milk, there was some one else provided to attend to the work, and thus the milk did not curdle.

"Very good," said Mr. Forbes, "but why cannot they do the same sort of thing with milk which is going to be sent away by railway."

"So they do," said Mr. Nicholson, "and it saves a good deal of milk from being spoilt."

Mrs. Forbes, wishing to make her peace with Mr. Nicholson,

inquired if he could tell her how it was they had so very much trouble at times in the cheese-room in the hardening of the cheese, and why some cheeses would crack and almost burst, whilst others seemed to go on quietly and become ready for sale with very little trouble.

In reply, Mr. Nicholson said, "that this was just one of those things which even chemists are puzzled about, and it showed how important it was that ladies should know something about the chemistry of milk, as their practical experience would thus help them to explain what can not be explained by chemists, who know little about the temper and habits of cheese."

"Do you intend to explain all about milk and cream and cheese in your lectures for the ladies?" inquired Mrs. Forbes.

"If I do venture to give them any explanation of these and similar matters," replied Mr. Nicholson, "I shall certainly avoid lecturing them, as I know I should get the worst of it for my presumption, but if I can get them to help me to explain some of their difficulties, both they and I may be gainers by it. Before we meet again try if you can find out why Mrs. Holmes' bread is so much better than that we get in town, and why country bread is such a treat to those who are accustomed to bakers' bread? I want to know something more about this, and you ladies can help me. Now, Jack, you must not let them forget about it."

The ladies, however, promised that they would help in the work, and some future meeting was hinted at. Holmes, in bidding good-bye to Charlie Robinson, said, "he hoped that he would practise himself in the English language a bit more, not only for his own sake, but for telling others what he knew of chemistry, for he thought the use of such out-of-the-way terms often prevented people from understanding what was known, and in some cases was even made a cloak for ignorance. But we have not seen the clover, Mr. Nicholson. I declare time has gone so quickly we have not done one-half I intended you to do. I really wish you would come over again."

CHAPTER VII.

EXHIBITION BEAUTIES.

DR. WHICHCORD having offered seats in his carriage to Mr. Nicholson and his friend Charlie Robinson, they were soon on the road for Wrexborough, and the Doctor explained his views to Mr. Nicholson about some experimental trials of manure in that neighbourhood. They were both agreed in the general policy of the work, and each expressed a willingness to aid in its execution before they parted.

"Well, Nicholson," said Robinson, "I don't think so much of your friend Holmes. He is much too personal in his remarks to please me. I see no reason why you should bring science down within the reach of every tomfool."

"Come, come, Robinson," remarked Mr. Nicholson, "that won't do. The fact is you thought to choke him off by using terms you knew he could not understand; but by telling you this plainly he placed you in a position which necessitated your explaining it to him in a way that he could understand, and it strikes me that my friend Charlie Robinson couldn't do it."

"Well, if truth must be told," said Robinson, "I did not know more than I had told him, and I knew the answer was right, so I stuck to it; but, confound the fellow, he carried off my wickets sharp."

"Take my advice, Charlie," said Mr. Nicholson; "if you cannot understand what you are taught in College, act as Holmes did to you, and ask your professors whether the English language is not rich enough to enable them to explain matters in English without introducing other languages simply for ornamental purposes."

Robinson tendered his thanks, accompanying it with a very peculiar whistle, which was rather suggestive of non-compliance in the recommendation given.

As soon as the carriage had wheeled away from the farm, the little party were soon in consultation, for Mrs. Holmes at once asked her sister if she could see how they were to reply to Mr. Nicholson's inquiry about the bread. Before she could make any reply Mr. Forbes remarked, "I am glad you have got something to puzzle you, for when people think they know all about everything, they are easily offended if any one offers to teach them. Mr. Nicholson was quite right when he said if he could get the ladies to help him to explain some of their difficulties, both they and he would be gainers. Now then let us try to thresh out this question he asked about the bread. What do you say, Mrs. Holmes?"

"I only know," said Mrs. Holmes, "that it wouldn't pay me to buy bread for our use, for bakers' bread never seems to satisfy the appetite. If they eat it when it is quite new it gives them indigestion, and if you keep it two or three days it gets too dry and stale, but our bread is as good for eight or ten days as it is on the day it is baked. What do you say, Jack?"

Jack told them that when he had bakers' bread he always wanted something with it, but he could enjoy their bread as it was.

"Ah," said Holmes, "it is as the shepherd said this morning about the swedes not being as proofy as they ought to be. But after all, this does not answer Mr. Nicholson's inquiry; he wants to know why it is so, and we have only got to the old woman's answer—because it is. That won't do for him, and I am afraid we shall not get beyond this until he comes to help us."

Not many days after, Holmes told Jack on his return from work that Mr. Thompson, the steward, had called and wanted to know if he was going to the show of the Royal Agricultural Society, which was to take place within easy reach by rail, and he recom-

mended that Holmes should take Jack, and that he had arranged to do so. The day soon arrived, and both at length entered the showyard. Few sights are more impressive than the extensive arrangements made for one of our national exhibitions, and however much Jack was astonished by the general view of the exhibition, Holmes was almost equally surprised.

"Well, Jack," said Holmes, "what shall we see first?"

"Let us see the sheep," replied Jack.

It was indeed a grand display, and Jack gradually realised, as he passed on, what was meant by a well-made sheep—more, in fact, than he had ever done before. His father's flock was one of good, useful quality, but, in comparison with these, they appeared a poor lot. Jack was disposed to linger amongst the sheep, for the young fellow loved them; and when Holmes told him they must go on, and asked if he had picked out his favourites, he was quite ready to point to two pens of ewes, either or both of which would have rejoiced his heart to secure for their farm.

"Well, Jack," said Holmes, "we will talk to shepherd about these two lots, and if he thinks they will do for our farm we will try and buy them."

Jack could scarcely believe his ears, for he now felt sure they would have the ewes, and that shepherd would be glad to have them added to his flock. After taking another look at his favourites, he went the more willingly to see the cattle; but although his fancy did not run so much in this direction, his astonishment was unbounded at these marvels of growth. His surprise found no expression in words until he came to the cows in milk, and he was more than ever astonished to be told that some of their own cows at home would give several times as much milk as these. He naturally inquired how it was they didn't care about their giving more milk, and how they managed to suckle their calves?

Holmes explained to Jack that they seemed to care more about shape and fat than milk, and they got much of the milk for the

calves from other cows; but that he didn't like the plan, for he thought if they chose to do so, they could make their cows better milkers, and it would be better for the calves in many ways. Jack left the cattle with less regret than the sheep.

The horses, pigs, poultry, and implements offered such an extent of sight-seeing as stretched Jack's feelings of surprise to their most extreme limits, and when the day was drawing to a close, his mind seemed almost confused with their endless variety, and he said—

"I am really too tired to look at anything else."

Early on the following morning Jack told the shepherd about the two pens of ewes he had chosen in the show, saying his father had promised to purchase them if he thought they would do well in the flock. George would willingly have spared Jack the disappointment, but he was obliged to say—

"They ewes won't do for us at any price, any more than as many Duchesses could do in my cottage. They have been accustomed to rare good keep, and if you keep them up as fat as they are now, they will never do well. No, Jack, it won't do; they be beauties no doubt, but they have been spoilt for us by being fed up for show. It is a pity, no doubt, but these big breeders must make a sacrifice for the credit of the flock. I knows all about it, Jack, for I had to help for some years on a farm where they showed their sheep almost every year, and I heard the master say as much."

Jack told his father what the shepherd had said about his favourite ewes, but instead of his being surprised, he said—

"I knew, Jack, I could safely promise to buy those ewes, as there was no chance of George wanting to add to his troubles. We must have something hardier and more useful for our purposes, but you won't forget your favourites in a hurry, I think, nor the lessons you may learn from George's decision."

CHAPTER VIII.

THE LADIES DEMAND EQUAL RIGHTS.

MR. NICHOLSON soon called again on Mr. and Mrs. Holmes, and was welcomed by them, not as one who was paying his second visit, but as an old friend, for such he had become in that household.

"Anything new in Wrexborough?" inquired Holmes.

"The only news I have," said Mr. Nicholson, "is from the Doctor. He called this morning to say that he was at the Castle yesterday, and spoke to the Squire about the experimental trials, and he says he will gladly help with some of his friends to get the thing done. He proposed that Mr. Thompson, you, and I, should make the arrangements in time for another season, and pick out some five or six farms in the neighbourhood which would compare fairly with each other. He also said he should come over some day and see how your experiment was going on, for he thought it was a move in the right direction. He told the Doctor he should like to come and see my class begin their work next winter, so you see we shall begin under good patronage."

Holmes was greatly pleased at the news, for the Squire was a good landlord and wished well for his tenants; but he was so engaged in political affairs that he rarely saw his tenants except when shooting over their farms. Mr. Nicholson naturally inquired of Mrs. Holmes if she and her sister had come to any conclusion about the bread question, and having been told what had transpired he proposed to defer saying anything about it until after they had had their walk over the farm.

Holmes and Mr. Nicholson walked quietly away for the clover

field, and Holmes explained all that had been done, and that the cut of clover on the one piece was nearly three times as good as on the other, and that it appeared to be of much better quality, as there was no weed rubbish grown up in it.

"Yes," said Mr. Nicholson; "this is a very good experiment, although you did not intend it as one. I often find that many of our best lessons are to be learnt from accidental work of this kind. It is certain that you have gained something considerable in the clover crop, and the second crop looks as if it were going to do similar good work; but I shall be much mistaken if you don't find a marked difference in the wheat also. When this ley is ploughed you will find much more clover root in it than on the side which the ewes ate down for you last autumn, and you know as well as I do, that the wheat rejoices in a close network of these roots to feed on. Your experiment here won't end this season, I can see. Now let us go to the swedes."

Here they found Jack helping at the hoeing, so Mr. Nicholson naturally inquired of him if there was a good plant on the ground.

"Yes," replied Jack; "it's good everywhere, and yet the fly has been very thick; but father had some mustard sown, and the fly took to it and scarcely touched the swedes. This was what you recommended, if you remember, and it answers well. George was telling me that Mr. Humphreys, of the Grange, has tried a little mustard for some years past, and he finds it answers very well."

Mr. Nicholson contented himself by saying that the rule to be followed was to get some quick-growing but cheap seed, which should yield a leaf which would keep the fly well fed while the swede was getting into rough leaf; and probably some other seeds besides mustard would come into use.

In looking over the field, there was no doubt as to which of the swedes were growing most rapidly. The double dose of superphosphate was clearly beating the smaller quantities of superphosphate upon the dung.

"But," inquired Mr. Nicholson, "how was the larger lot of superphosphate applied to the land?"

"We drilled that lot with the seed," said Holmes, "for I thought we wouldn't risk all the field by sowing nearly all broadcast. We farmers must be cautious, you know, Mr. Nicholson. It is a serious matter to us to lose a crop."

"Never mind, Holmes," said Mr. Nicholson. "You will have some good swedes, but I think you will find before winter that those which are now leading away so fast will be overtaken by the others, and that the slow and steady ones will after all win the race. But how about the other two superphosphates—the 28 and 23, you know?"

These on examination looked as equal as possible, and nothing could be said for the present about them one way or the other.

When the walk on the farm was ended, Holmes brought Mr. Nicholson in for some tea; and, much to his surprise, Mrs. Forbes and Jack awaited their arrival.

"You see, Holmes," said Mrs. Forbes, "your wife kept her promise, and sent over the gig for me as soon as Mr. Nicholson had come, for I want to hear what he has got to say about the bread, and then I must ask him about another dairy matter."

"Come, come," said Mr. Nicholson, "this is quite turning the tables upon me. I was expecting to hear what conclusions you ladies had come to, and now you want me to tell you about it. That was not my bargain at all. I really meant what I said in offering to help you, if you would help me. As to the facts, I think we are agreed that Mrs. Holmes' bread is very much better than ordinary bakers' bread."

"I said that the one is more proofy than the other," interposed Holmes, "just as shepherd says of the swedes."

"There, I think, you are right," continued Mr. Nicholson; "in other words, it has got more nourishment in it, but how this is I am not quite prepared to say. Of one thing I am sure, that in Mrs. Holmes' bread you have got no adulteration, and this you

cannot always say of bakers' bread. A case came under my notice some years ago in which a miller had two mills adjoining, the one a flour mill and the other a paper mill. The store-room was made use of for both the mills. A strange man was sent to the store for some alum to mix with the flour, but going to the wrong cask he brought some sugar of lead, and it was mixed with the flour instead. As soon as the bread came into use the doctors were quickly busy, and the town crier went round telling the people not to eat the bread as it contained poison. The miller, however, confessed the mistake, saying that in some cases he used alum with the flour, as people would not buy bread which did not look nice and white."

"Very likely it is the alum which makes the bakers' bread have a sour taste so soon," said Mrs. Holmes.

"It is only fair to say," added Mr. Nicholson, "that we must not charge all millers with this offence. They have to meet the requirements of their customers, and I suppose it is no secret of the trade that there is a good deal of difference in flour. A miller who was going to send flour for Mrs. Holmes to use would not send the same flour to a baker, because they want different kinds of bread, and what would suit the requirements of the one would not suit the profits of the other. A baker wants a flour which will carry the greatest weight of water, so that he may have the heaviest weight of bread for sale; and if the colour is not white enough, this difficulty must be got over by some means or other. Mrs. Holmes, on the other hand, wants her bread of a natural colour, and she does not want its weight increased by water, which will pass off in a day or two, leaving the bread harsh and stale, so the miller has no special trouble in preparing her flour. I do not think, however, I go too far in saying that there is much more to be known about the preparation and use of flour, before we have learnt how to use it most profitably for the rich as well as for the poor. It is in this work I want you ladies to help me, and I shall still hold you to your promise."

"Anything we can do to help," said Mrs. Forbes, "I am sure we shall be pleased to do, and now we know more about it we may be able to do so. But I want you to tell me why I have so much trouble about potting my spring butter. Many people cannot pot this butter, and I am not much better. Can you tell me why there should be this trouble in the spring, which passes away as the summer comes on."

"The only clue I can give you is the fact that spring vegetation has a vigour of growth which makes the cream richer in fermentable matter (what chemists call nitrogenous matter) and this has such a restless character that it stirs up a sort of revolutionary action in the butter, and so it will not keep."

"But," inquired Mrs. Forbes, "do you really think the sunlight is different in spring time, or differs at one time from another?"

"I know it is," says Mrs. Holmes; "why, didn't I go from home last spring, and I particularly asked Holmes to see that the blinds were kept down, so as to protect the new carpet in this room from the sun. Just like the men, he came into the room, had the blinds up, forgot all about the sun, and three days of the sun then did more damage to the carpet than three weeks of the summer sun. I know it is not always alike."

"Well then, Mrs. Forbes," said Mr. Nicholson, "it is quite possible that the sunshine may use this additional energy to arouse vegetation from its wintry sleep, and the early growth of herbage in spring may be stronger than usual. However, ladies, in this I think we shall all agree: you have duties to discharge which require the exercise of thought and judgment, and you will best perform those duties by knowing the nature and the character of the things you have to deal with, and this is what is meant by Science."

"If that be the case you really must arrange to let the ladies attend your lectures next winter," said Mrs. Forbes; "for I am now quite sure there is much about our work we don't understand."

"I say, Father," whispered Jack, "sha'n't we be a jolly party?"

CHAPTER IX.

THE SQUIRE'S VISIT.

THE glorious harvest weather made Holmes and Jack busy with the corn, and no idle hands were to be seen on the farm. The heat was great, but this only served to keep up a higher pressure, for all felt an interest in the crops of the farm. They never spoke of the master's corn; it was "our corn" and "our sheep." Holmes was a good and prudent master, and he had the good fortune of being able to inspire his men with feelings of mutual respect and good wishes. The steam was up indeed; the machinery of the farm was working at its best, and the corn was being rapidly gathered in, and in consequence the fuel and liquor required for these animated locomotives had to be freely but prudently supplied. It was hard work, it is true, but it went on right merrily; and it was in the midst of this scene of labour that the Squire found Holmes and his party when he rode over to pay his promised visit.

"Health and happiness to you all," shouted the Squire, as he reined up his horse; "and if you pass me your firkin, Holmes, I'll drink to it with all my heart."

"Well, sir, we have got two taps going; we have got some light ale, and we have got some cold tea—which may I pass to you?"

"I'll try the ale," said the Squire; "and now I drink to your health and happiness."

"Now, all hands," shouted Holmes, "here's the Squire's good health, and right glad we are to see him."

The order was heartily obeyed, and the Squire proceeded to inquire whether the men liked the tea instead of the ale.

"Well," said Holmes, "the fact is, I like them to have their choice, for, working as they do in the sun, men must have plenty to drink; and if they have nothing to drink but ale, they either do not drink as much as they want, or they get rather fresh, and neither they nor I like that, so I have some cold tea as well, and they drink quite as much of it as they do of the ale."

"But do you think there is any goodness in the cold tea?" inquired the Squire.

"Well, sir, I don't pretend to know how that is, but one day, when I went into Wrexborough with Jack to hear one of Mr. Nicholson's lectures, I heard him say that both coffee and tea gave a stimulus which enabled men to labour for a longer time than they could work upon ale, and they had less effect upon the head; so I thought we would have both, and let the men take their choice."

"So I suppose, Holmes," replied the Squire, "your men are refreshed without getting fresh. Well, I shall leave my contribution to the men's club; and now I want to have a look at your swedes."

Holmes acted as guide for the Squire, calling Jack to come and hold the horse. They spoke of Mr. Nicholson's lectures during the winter on their way, which Holmes said had made them think about what they were doing.

"Speaking as a practical man," Holmes said, "I think we shall gain much by knowing more of what we are about, and why we find it best to do things as we do."

"And so these are your swedes?" said the Squire. "Now let me know all about them."

Their history was soon told; but progress had been made in their growth since Mr. Nicholson had been there. The swedes which were then leading in the race had still the biggest bulbs, but their leaves told the tale that their race was well-nigh finished.

The mildew had settled on the leaves and nearly covered the surface. The sight was far too familiar to Holmes, and he knew he had little more to hope for there.

"Jack," said Holmes, "as soon as the Squire is gone you must tell Tom to bring up the strong horse-hoe, and let him take off the shares, and put in the stirrers, and tell him to work between the rows as deep as he can. This mildew has increased wonderfully during the last few days."

"How do you account for this mildew, Holmes?" asked the Squire.

"I really don't know how it is, nor what the dusty stuff is," replied Holmes.

"I know," said Jack, "what Mr. Nicholson compared it to. He said all this dust was a number of very little plants which settled on the leaf when they had the chance, and were like thousands of little leeches sucking the goodness out of the plant. And he said the best plan was not to give the mildew the chance of settling on the leaf."

"Very good, lad," remarked the Squire, "but did he tell you how you could prevent the mildew pitching on the leaf."

"Oh yes, sir," replied Jack; "just look at the rest of the field. Those swedes are growing, and the mildew can't pitch there; these have run themselves until they are dead beat, and because they can travel no further, the mildew settles upon them. I recollect Mr. Nicholson saying that in the East, where they have very long journeys to make, some of the camels and horses are sometimes worn out, and can travel no further. The vultures and carrion crows soon pitch upon those that are dead or disabled, and feast upon them, but they don't touch those that are travelling on; and he said so it was with the swedes. If they stop growing in the hot, summer weather, down comes the mildew like the vultures, and they feed upon the swedes, and so they have little chance of growing again. The only hope, he said, was to stir the ground deep, and if some rain came soon they might

make a start before much of the goodness had been sucked out of them."

"I am very pleased, Holmes," said the Squire, "to find your son remembers what Mr. Nicholson told him. I promised Mr. Nicholson to attend the first lecture of his next course, hoping I may encourage the work, and now I shall do it with the greater satisfaction. I must get Thompson to see some of my other tenants, and get them to give their lads a chance."

"It won't do any of us farmers any harm to go as well," said Holmes. "It can't do us any harm to be set thinking a bit about our work, so I am the more pleased to hear you mean to come to the first lecture."

"Good day to you, Holmes," said the Squire. "I have been much pleased with what I have seen on your farm, and not less so with what I have heard. Good-bye, Jack; stick to your work well, and when I come again I will see if you recollect anything else Mr. Nicholson told you."

The Squire was soon homeward bound, and Jack was quickly off to get the horse-hoe at work in the field.

No very great success attended the horse-hoeing, for the continuance of dry weather, so good for the harvest, was unfortunate for the mildewed swedes, which would have been helped by rain. The general tillage of the other swedes was properly attended to, and they kept up a steady growth. When at length the rain did fall they were helped on greatly by it, and by the end of September the slow growers had clearly made the greater size. In fact they kept on their steady pace well into the month of October, and when they ceased to increase in size they still continued to get more solid. As Jack was then helping the shepherd again, both went to have a look at the swedes.

"Well," said George, "there is no mistake about a difference in these swedes. Just you take one of them in your hand, and then let us go to the mildewed swedes. Do you notice any difference in the weight and hardness? You cut them with my

knife; that'll tell you which is hardest. Now you taste a bit of each."

"There is a difference, George, and no mistake," said Jack; "and if you look at them where I cut them, it is just as Mr. Nicholson said, in one case you have got storehouses which have never been used, and yet they want to be repaired, and in the other case the store rooms are filled with good food."

"Just so, Jack," continued the shepherd. "Well, master told us he saw some swedes last season three times as good as ours. He will say there is as much difference in this field when he tries them. Tom, when he drilled those on the dung, said we weren't putting in enough manure with the seed. He don't say so now, for they are a very good and equal lot all through. We shall do better for the ewes this winter, Jack, and I hope master won't spare the hay. We sha'n't want much, but I'd like to begin early enough this time, and then we shall have a better time of it in the spring, I hope, for things were awfully bad last season."

CHAPTER X

A GOVERNMENT SCHOLARSHIP.

MR. NICHOLSON issued the notices for his second course of lectures under much more favourable circumstances than the first, and the number of applicants greatly exceeded his expectations. The action taken by Mr. Woodford's steward had led to the object of the lectures being made better known. A week before the time fixed for their delivery it became clear that a larger lecture room was necessary, as the list very nearly reached 100. With the help of Dr. Whichcord the difficulty was overcome, and when, in accordance with the previous arrangement, Mr. Woodford presided at the first lecture, a goodly gathering of attentive listeners welcomed Mr. Nicholson to his duty.

In that gathering Mrs. Holmes and Mrs. Forbes found many other ladies associated with them, and the number of men was fully as great. The boys were brought to the front, and the adults arranged themselves behind according to their inclinations.

The Squire, in introducing Mr. Nicholson, took occasion to remark that a very important work had been proceeding in their midst which had not been half as well known as it deserved to be. He had come forward on this occasion, hoping it would encourage his tenantry to give attention to Mr. Nicholson's lectures upon agricultural science. He was glad to learn that the Government had determined to render the same assistance to the Principles of Agriculture which had for many years been given to other branches of Science. It was his intention at once to put himself in communication with the Government Department of Science, and establish a Government Scholarship of £50 a-year for the pupils

of the Wrexborough Science Class, so as to enable the best of these pupils to go to some good College for one or two years, and make higher progress in science. He hoped, when the scholarship was awarded in the following June, that it would be given to someone who would become a credit to the school, and hereafter a credit to his estate.

The first lecture was largely devoted to an outline of the general work to be accomplished in the course. Jack noticed that it extended beyond the limits of the first course; but there was, withal, a certain similarity which satisfied Jack that he remembered much of the previous lectures. Although the class was differently constituted from the former, Mr. Nicholson evidently did not intend the work to lose any of its completeness. The lecture did not at first entirely fulfil what Mrs. Holmes and Mrs. Forbes had anticipated; nor were they the only ones who found that the acquirement of the alphabet of science needed labour and persevering care. Mr. Nicholson's endeavour was to teach them as far as possible by stealth, and by a familiar representation of what are commonly regarded as scientific difficulties, they often realised the truths which were therein embodied before they were staggered by the difficulty. At the conclusion of the first lecture Mr. Woodford expressed a hope to be present with them on some future evenings, for he was not only greatly pleased with the work, but also much interested in the subject.

On leaving the lecture, the conversation naturally turned upon Mr. Woodford's handsome offer of a scholarship.

"This is something quite new, I suppose?" inquired Holmes of Mr. Nicholson.

"Yes," he replied; "it is quite a recent arrangement which the Government has made, which gives this opportunity for boys who want to study agricultural science; but it will be some years before farmers will believe it—in fact, it looks almost too good to be true. Possibly you remember the trial of human nature made by one of our noble lords, who stood on London Bridge offering

sovereigns at a penny each. He never sold any, because the offer was thought to be too good to be true; but can you not imagine the vexation of those who had heard the offer and passed on, when they afterwards found out that they might have had some real good sovereigns at a penny each?"

"I wish they would give me the chance," said Jack. "However, I think I went in for some true gold before many who were here for this evening's lecture."

Week by week the work progressed through the winter months, and many a cheerful interchange of views took place over the incidents of the lectures. At times it needed good sound British pluck to face the walk or drive when the weather was unfavourable, but Mr. Nicholson had a thoroughly good attendance throughout his course of lectures. The exchange of views which took place near the Great Willow Tree had many similar counterparts, and the merry faces of the class showed that all was not dull drudgery, but that the work often carried its own consolations. At length, however, the course of lectures was completed, and notice was given by Mr. Nicholson that the Government examination would take place about the middle of May.

Jack had worked throughout with steady perseverance, and as this winter he had been driven into Wrexborough almost every week, he was much less tired than usual after his return, and his notes of the lectures were consequently more complete than usual. Many a time had he to refer to them to satisfy differences of opinion, and aided by his natural quickness of thought Jack gradually got to be a sort of referee. He certainly had had the advantage of taking a preliminary canter over the ground, and it is not saying too much for him that he made good use of this opportunity, which greatly helped him in the second course of lectures. With many cordial expressions of thanks to Mr. Nicholson, the lecturer and his class parted after the winter's course of instruction. The seed had been sown in the minds of many, but to trace the various issues would lead us beyond our

specified limits; suffice it to say when once the mind is awakened to a thirst for knowledge there is a great probability of the search being successful.

The middle of June had scarcely arrived when Mr. Nicholson received notice from the Department of Science that John Holmes had gained the Woodford scholarship attached to the Wrexborough Science School, with a request that the Department might be informed in which of the Colleges approved of by the Council of Education the scholarship would be held. Mr. Nicholson at once put himself in communication with Mr. Woodford, informing him of the award of his scholarship, and by the Squire's direction Mr. Thompson and he became the bearers of the pleasing news to Jack and his parents. To each it appeared to be a surprise, but there was something in the mother's smile which told of a hope long cherished, but never declared.

"Jack," said Mr. Thompson, "the Squire bids me say he hopes you will go on as you have begun, and he wishes you every success; but he also hopes that you will remember that your College work is but a preparation for learning more perfectly at home the duties of successful farm management."

Mr. Nicholson told Holmes there would be two or three months before they need decide about which College would suit best for Jack, and in the meantime he would look into the matter for them.

The spring and the summer found daily duty for Holmes and Jack, for in addition to the work upon the farm, the experimental plots of the district had been arranged in accordance with the Squire's wish. Upon Jack devolved the frequent duty of helping to keep all going on alike; altogether he had a busy time of it, and so it passed quickly. The harvest time was passed with cheerful merriment, with little disposition to intemperance, and at the harvest supper hearty indeed were the good wishes of the men for Jack's success.

The necessary arrangements were at length completed by the

kind help of Mr. Nicholson, and Jack's name was duly entered upon the books of Rodney College. Many a hearty cheer was given him as his father drove with him to the railway, and full of hope for the future he entered upon a path which was to him as yet unknown, but by no one was this hope more deeply felt than by his mother, as she took her parting look at Jack as he passed beneath the Great Willow Tree, brilliant once more in the golden hues of autumn.

CHAPTER XI.

RODNEY COLLEGE.

HOLMES had not long to wait at Wrexborough station for the Northern Express.

"Good bye, Jack; don't forget the Squire's message, and our good wishes," said Holmes, as Jack took his seat in the train.

"Trust me. I will do my best. Good-bye."

Such was Jack's farewell reply.

Scarcely had he time to notice his companions before a gentleman seated opposite to him entered into conversation with him, and learning that he was proceeding to Rodney College, he having but recently come over from America, quickly turned the conversation upon the Colleges in the United States.

"England," he remarked, "has much to learn from the States as to the encouragement of those who devote themselves to the cultivation of the land. I happen to be a member of the Board of Agriculture for the State of ——, and I have therefore an opportunity of knowing what is being done there for agriculture. Very great help is given to our youths by our several State Colleges, for these are not only very superior educational institutions, but young men—such as yourself—can enter at a small cost, for they allow them to take part in the work of the farm, and in this way the pupils contribute to their own support. I dare say your father has to pay £75 or £100 a-year for you at Rodney College?"

"No, sir," said Jack; "our landlord and the Government send me, without any cost to my father; and if it had not been for this help, I should not be going to College now."

Jack was then called upon to explain the system of the Government Scholarships, and the circumstances under which he had gained one of them.

"Excuse me, sir," said another passenger, who had been listening attentively to the conversation, "but I am a farmer, residing in the Midland Counties, and I am, therefore, much interested in this subject. Would you mind giving me some particulars as to what your Boards of Agriculture do in the States?"

The American gentleman promptly responded by saying, "In our State, for instance, the Board of Agriculture consists of five members appointed by the Governor and Council of the State, one member chosen by the State Agricultural Society, one member chosen by the State Pomological Society, another member chosen by the State Poultry Association, and sixteen members elected from the various County Societies. It is the duty of our Board to see to the promotion of education amongst the youths who are growing up to be farmers, as well as amongst those who are already engaged in business as farmers. We do not consider education limited to schools and colleges, but a work which must be constantly going on, even amongst those who are men of experience. We secure the help of the best men to give lectures, and read papers on subjects of importance. We have to report to the Senate and the House of Representatives the condition of agriculture, the character of the crops, the causes of success or failure, and generally to render official assistance to the farmers of the State. I think we may say without any unfair boasting, that we are thus able to do much for the agriculture of each of the States."

"But," inquired our Midland Counties friend, "do you find that the young men in your Colleges are willing to take any real share in the work of the farm, and are still able to attend to their studies?"

From the explanation given it was clear that very much depended upon what young men had been previously accustomed

to. If a youth had been in the habit of working hard, he found the time devoted to study a relief from labour, and he could profit by it. On the other hand, a pupil who had not been accustomed to work hard, was so wearied by the labour that he could not give proper attention to the instruction. The pupils did not progress so rapidly with this double duty, but it was considered in the States that a sounder practical education was thus obtained than could be otherwise secured.

Jack, who had known what it was to work hard upon the farm and attend lectures afterwards, listened with intense interest to the conversation. He was now entertaining the hope of making far greater progress, because he would be free, for a time, from the labour of the farm. "For his part," he said, "now that he had taken his fair share in the work of the farm, and had learned something of the way things should be done, he thought he should progress better by giving all his time to lectures and study, for when he returned to his father's farm he could perfect himself in farm work."

With such companions, and with subjects for discussion in which each took a warm interest, the journey was pleasantly passed.

The afternoon of the day was well advanced when Jack, for the first time, rang the entrance bell of Rodney College, and giving his number to the hall porter, the luggage was taken to room No. 68, and Mr. John Holmes was asked to follow to it.

"This is a jolly room," said Jack to himself, as he entered. His bed occupied a recess in the side wall, which was screened off during the day—an arrangement which left the room apparently as free as an ordinary study, and the clear space, although small, was abundantly sufficient for his requirements. A good chest of drawers fitted with a book rest over, a dressing table—which by day assumed the appearance of a study table—a good writing table, two chairs, and a carpet, constituted the entire furniture. There was nothing very particular in their arrangement,

but the room presented altogether an appearance of comfort, which, after careful survey, led Jack again to say "a jolly room for quiet work."

It did not occupy Jack for any great length of time to distribute his worldly goods in their proper places, and having refreshed himself from his journey, he resolved to wander forth and see something of the College arrangements. He naturally retraced his steps to the entrance hall, and watched the arrival of other students. Amongst these arrivals was No. 67, a slightly-built and rather delicate-looking young man, named Webster. Jack noticed him with the greater interest as he thought he must be his next door neighbour. The hearty greetings of the old students readily distinguished them from the new comers, and Jack came to the conclusion that Webster and he were both freshmen. The arrivals gradually increased in number, and the cheerful voices made the hall and corridors ring again with merriment. At length the nine o'clock bell rang for supper in the dining-hall, and all took their seats according to their respective numbers. Jack found himself seated opposite to Webster. As most of the students had come from a distance, a substantial supper had been provided, and evidently met the requirements of the party. The hearty conversation of the old students rapidly extended to the new comers, and Jack was soon conversing with Webster and their neighbours. Their first meal was thus made very enjoyable, and they soon became acquaintances.

As they were going to their rooms after supper, Jack asked Webster whether he had unpacked, and his offer of assistance in the unfinished work was gladly accepted. Webster's clothes and books did not cause much trouble, but Jack was utterly astonished at the rest of his luggage. In short, Webster's hobby was physical science, and as he had spent his holiday moments and most of his pocket money in making and purchasing various kinds of apparatus, he had got some useful things which he would not leave at home, for his heart was with them. The two young fellows exer-

cised all their ingenuity, and by the use of Webster's boxes—some of which were sacrificed for the work—they managed to get his traps satisfactorily arranged. This, however, sadly reduced the available space in Webster's study, but this was to him a matter of very secondary importance in comparison with the pleasure of having his apparatus around him. Jack and Webster both retired to rest that night with feelings of quiet satisfaction, and with sanguine hopes for the future.

CHAPTER XII.

NEW FRIENDS.

THE College work began in real earnest on the following morning, and each of the new comers had to present himself to the several Professors of the College with a printed form, to which each of the Professors added his general opinion as to the respective attainments of the student in the different branches of science. These reports were finally passed to the Principal, and by him brought under the consideration of the Senate, which consisted of the entire staff of Professors.

So far as Jack was concerned, the general summary of his report showed—that he had some knowledge of the principles of agriculture, very good in the chemistry of agriculture, no knowledge of botany and physiology, no knowledge of veterinary surgery, but some useful knowledge of stock; no knowledge of physical science or surveying, good at arithmetic. Consequent upon this preliminary examination, Mr. John Holmes was directed to attend the lectures upon the principles of agriculture, chemistry, and mensuration, the class for book-keeping, and the practical class in the laboratory. He was to attend the course of lectures upon physics, receiving supplemental instruction under one of the science tutors, and he was further directed to enter the preparatory classes in the schools, in order that he might prepare for the lectures upon the other subjects.

The principle upon which the Senate acted, was to take care that students did not attend the lectures upon any science until they had learnt the alphabet of that subject, and were quite able

to take proper advantage of the higher class instruction given by the Professors. In some exceptional cases, the science class work was made use of as supplemental to the lectures. As a rule, the students who needed class instruction were placed in the tutors' classes, until they gave proof of a sufficient knowledge of each subject to justify their removal to the lecture classes.

The students who were under the instruction of the Professors and tutors were not classified according as they might be new men or one year's or two years' men, but according to their knowledge of the respective subjects. One great benefit which was observable was the increased advantage it gave to the hard-working student. He soon separated himself from the idle fellows who would have not only interfered with the Professor's successful treatment of his subject, but prevented other men from taking full advantage of the instruction given. In some of our Colleges a few students in a lecture room, too ignorant of the subject to make any progress themselves, often interfere with men anxious to work, and make them miss the thread of argument upon which, perhaps, an entire lecture may be based. The system at Rodney College prevented this, and hence, when students were passed on for higher education, they were not only ready to take advantage of it, but they were, as a rule, persons who eagerly desired it. These students were intent upon real matter-of-fact work; and a fellow who was bent upon "skylarking" was as much out of his place amongst them as "a fish out of the water."

Another advantage which Jack soon saw in the system was that the students were thus always classified according to merit. It was quite immaterial how long a student had been in the College, he never took rank in a higher class than his work had gained for him, and was thereby constantly reminded of his weak points. If he were a genuine worker he soon succeeded in passing from his tutor's classes through the successive courses of lectures, and his position in the College was a fair proof of his ability and progress.

If he were without ability or without industry he was kept in the lower groups, and was not allowed to deceive himself or his friends by holding a false position, in which he would have been a source of trouble to those who had to be associated in class with him.

When Jack and Webster compared their notes respecting their preliminary examination papers, they soon saw a striking contrast in their attainments at starting. Where Webster was high Jack was low, each of them bearing evidence of differences in natural taste, and in their previous opportunities of school instruction. Webster was the son of an officer's widow; he had been accustomed to town life, and, although farming was settled upon as his future occupation in life, he knew very little of agricultural matters. His school education helped him greatly in some of his college studies, and his natural taste for physical science had enabled him to make considerable progress in this branch of study. It was, however, a source of satisfaction to both, that at any rate they could work together after the lectures, and Jack proposed that they should do so in his room, an arrangement which promised to be very advantageous for both. In fact, as soon as they had completed their notes of the day's lectures, the subjects of these lectures and their class work became topics for their joint discussion and explanation. Their different attainments enabled each in turn to become the examiner of the other, and each was able to render explanations to the other, so that they prospered in their respective classes in a very satisfactory manner.

The ordinary routine of college work progressed smoothly and with regularity. The end of the first month gave an opportunity for testing the progress of the students by the regular monthly examination. The Principal (Dr. Thomson) was particularly fond of examinations, and often expressed to the students his views upon this subject. In his earliest address to the students, at which Jack was present, he said:

"Gentlemen, you and I have something else to do besides

simply running through our daily course of instruction and study. We want to see that the seed sown is evenly distributed, and that steady progress is being made. The only way in which the Professors and tutors can satisfy themselves upon these points is by bringing you frequently to the standard for measurement, and hence examinations are, in my opinion, in the highest degree valuable. In these views I have the hearty approval of my colleagues. We all feel that we must not only help forward the more brilliant students to high success, but we must assist the more weakly of the flock. By our frequent examinations we find out our weaker students. In this way they come under our personal observation, and thus we have better opportunities for securing for them the assistance each may need. Besides this, gentlemen, we have by these means an opportunity of judging of our own work, for I readily admit that your success does not entirely depend upon yourselves, but upon both teacher and pupil discharging their respective duties aright. I also value examinations because I thereby see the result of our combined work; and I know full well that if these results are not sufficiently satisfactory, there must be a cause for it, and it is my duty to discover that cause and secure a proper remedy."

The students heartily concurred in the views expressed by Dr. Thomson, and Jack saw that the Principal thus secured not only the confidence and active support of the professorial staff, but he carried with him the sympathy and favour of the students. They could look upon him as a stedfast friend, whose avowed object it was to assist them over their difficulties, and to qualify them for the discharge of their future duties in life.

The first monthly examination showed to Jack and Webster the advantage arising from their daily discussions and private examinations upon the class work, for both held highly satisfactory positions in their several classes. In the lectures which they were attending both were doing more than average work. The result was very encouraging to their friendly co-operation, and they resolved

to adhere to the plan they had commenced working upon. Evening after evening found the two young men ready for their regular work, each with much to tell to the other, and the time at their disposal being well occupied, it passed pleasantly and quickly.

CHAPTER XIII.

A COLLEGE CONVERSAZIONE.

It was one of the rules of Rodney College that the monthly examination should be quickly followed by the College Conversazione. At the time fixed the Principal, professors, and tutors, with several of the gentlemen resident in the neighbourhood, met the students, and they were introduced to any of those present to whom they were unknown. Coffee having been served, and about half an hour having been occupied in general conversation, the Principal invited the attention of the company to the more formal business of the evening. On this occasion the Curator of the Botanic garden (one of the senior students) read an interesting report upon some of the results obtained from the experimental culture of our ordinary "root crops." The report commenced with a description of the wild sea beet, and growing specimens were exhibited of this, the parent plant, from which our several varieties of mangel wurzel had been cultivated. In appearance these plants were excessively unlike the cultivated specimens with which all were familiar. They formed small bushy plants, with dark green and rather fleshy leaves, but presented no indications of the large fleshy bulbs by which they are now so commonly recognised. Improved varieties of this plant—resulting from the selection of cultivated specimens for two, three, and four years in succession—were also shown, and the various transition stages towards the production of highly cultivated varieties—useful for tillage purposes—were contrasted with each other. Specimens of the wild and improving varieties of carrot and parsnip were also produced. These afforded striking contrasts between the wild

plants of our hedgerows with their tough roots, and the soft and nutritious roots of highly cultivated varieties. In like manner, the successive steps whereby our fine varieties of turnips and Swedish turnips had been obtained, were illustrated by roots in more or less perfect condition of growth.

An exceedingly interesting report was given upon the work which had been done in the botanic garden, and the author explained the manner in which the most promising plants were selected, and the care with which the desired peculiarities of form were watched for, and specially encouraged. He mentioned some interesting cases in which by the judicious use of manures, these changes were more rapidly accomplished, showing that the presence of a suitable food helped the botanist to modify the form of the plant's growth so as to favour the cultivation of large and fleshy roots.

On the conclusion of the report, Dr. Thomson invited any of the company to make inquiry or comment upon the subject which had been introduced that evening by one of the students. As this invitation was not very promptly responded to, Professor Maynard, with a desire to encourage conversational inquiry, commented briefly upon the important co-operation which different branches of science yielded to each other in meeting the farmer's requirements. He noticed the aid which chemistry rendered to the botanist by the supply of food which modified the form of the root, and rendered it valuable because it was thereby rendered more nutritious. He referred to the enormous crops which were now produced by the use of superphosphates, and strongly recommended their employment for the production of heavy crops of roots.

Mr. Bennett, one of the students, wished to inquire whether the production of heavy crops of roots might be fairly taken to represent a proportionately increased production of actual food? He made reference "to some important experiments which had been carried out in an adjoining district, in which it had been shown

that some manures increased the weight of a crop, without adding in the slightest degree to the food it contained, the addition being water. His friend, Mr. John Holmes, had recently mentioned to him some very interesting experiments in which he had been engaged, bearing in the same direction, all of which tended to show that there were other points for a farmer to consider besides the weight of roots produced per acre."

Much to Jack's surprise, the Principal asked him to give them some account of the results of these experiments. With some little hesitation, which the encouraging cheers of his fellow-students enabled him to cast aside, he stated that—

"Although my knowledge of farming is very limited, there is one thing I have learnt, and that is that there is a good deal of difference in the quality of swedes. In some cases they are scarcely worth eating, whilst in other cases they are good sound food. I have seen our ewes at home eating as many as they could hold, and yet not able to satisfy their hunger. I have seen them at other times satisfied with a much smaller quantity, and doing well with less than half the supply of roots. Our shepherd and I have often talked the matter over, and he was satisfied from the use of swedes that some were three times as good food as others were, that is weight for weight. Science, he knew, had done a great deal of good for farm crops; but, for all that, he had learnt that it was possible to use the whip too much, and make root crops grow too fast for them to be got of the best quality. He had also been taught that nothing was so dear as when you got too much for your money, and this was a lesson which should be more generally learnt. Their experiments had been suggested by his late tutor, Mr. Nicholson, of Wrexborough, and they showed that it was quality the farmer wanted to secure in the first place, and the more he could get, without a sacrifice of quality, the better it was both for the person who farmed the land and for the person who owned it."

Professor Armstrong, who followed, complimented Mr. John

Holmes upon the correct views he had expressed and in which he fully agreed. He added:

"Speaking as I do from a professional point of view—as a veterinary surgeon—my experience has proved to me, that food of a low nutritive character is a very fertile cause of disease in all kinds of animal life. The desire for food remains unsatisfied when a fair bulk of food has been taken, and consequent upon this craving for more food—to supply the deficiency in nutriment—the system gets overloaded and deranged, and the animal is thereby predisposed for sickness and disease. For the preservation of the health of farm stock, it is clearly the farmer's first duty to grow food of the highest nutritive character, and it was also his interest to grow as much as he can without a sacrifice of quality."

After a lengthened discussion and many inquiries, the Principal said:

"The time usually devoted to the more formal part of the duties of the evening having expired, I will, with your permission, tender a vote of thanks to the Curator of the Botanic Garden, who has brought before us such an interesting subject. I must also congratulate Professor Richards upon the success of his able lieutenant. It has been exceedingly interesting to see and hear of the manner in which, by skilful arrangements, rough and apparently valueless plants are altered in form and character, and rendered valuable for the cultivator of the soil. It is, however, most important to maintain the high quality which has been obtained, and it is therefore necessary that each and all in our respective sections, should seek to promote these results as we have the means and the opportunity."

The meeting then resolved itself into one of cheerful intercourse, and gave the Principal and Professors many an opportunity for a kindly word of encouragement or advice to the students. This course of procedure laid the foundation for a friendly feeling between the staff and the students, which encouraged the latter to seek that counsel and guidance in difficulties which the Pro-

fessors were always glad to render. It had the further advantage of enabling the students to be known to the gentlemen of the neighbourhood, contributing not only to much pleasing association, but also exercising a softening influence upon the frivolity of youth. It encouraged that feeling of self-respect in the students, which goes far to check that boisterous and unruly behaviour which soon degenerates into a form open to censure, and to its influence might be very largely traced the well-known gentlemanly behaviour of the students of Rodney College.

During the evening Mr. Fergusson, of the Lodge Farm, entered into a long conversation with Jack upon farming matters, and was so interested in his quiet but intelligent manner, that he asked him to come over and see his farm. As it was only a 3-mile walk, it was arranged that, with the Principal's consent, he would come over as soon as work was done on the following Saturday, and bring one of his fellow-students with him. It did not take long to complete the arrangement, for, having asked Webster to go with him, the invitation was gladly accepted.

The pleasures of the conversazione had much novelty for Jack's mind. He found himself thereby more fully acquainted with his Professors, and more ready to look upon them, as well as upon the Principal, as his friendly helpers. In fact, Dr. Thomson had told Jack that he considered these friendly gatherings were calculated, in his opinion, to facilitate very materially the work of the College.

CHAPTER XIV.

LODGE FARM.

It was soon after noon on the following Saturday that the two students left Rodney College for the promised visit to the Lodge Farm. The day was bright but cold, and was just one of those bracing, frosty days of early winter in the North which inspire one with renewed energy and strength. The walk was quickly accomplished, and Jack and Webster were soon the guests of Mr. Fergusson. The splendid range of farm buildings at once attracted the attention of the young men, for neither had seen any of equal size; but although they were naturally anxious for the tour of inspection that had been promised, neither was so far carried away by his curiosity as to reject Mr. Fergusson's offer of refreshments. This, indeed, the previous walk enabled them to do considerable justice to, and afterwards they proceeded with Mr. Fergusson to have a look at the farm. One of the first things pointed out when they went through the farm buildings was the arrangement for preserving the manure in the yards. There were tanks constructed underground for receiving the drainage from the buildings and from the yards.

"At one time," remarked Mr. Fergusson, "I used to have the liquid manure which collected in these tanks carted out upon the land and made good use of there; but I have found it much more profitable to use it upon the manure we keep in this covered yard. One of the great objections which I had to covered yards was the waste of manure arising from the manure becoming too hot during its fermentation. It is true the roof protected the manure from the rain, but the ammonia was driven off by a waste-

ful fermentation. I prevent this now by having the liquid manure pumped over it from time to time, and in this way we secure the manure from loss, turning it out at last in a condition worthy of the name of farmyard manure."

Jack well remembered at least one instance in which far less care had been taken of the manure, but he had never seen anything so perfect as these arrangements for preserving it from waste. They were then taken to see the steam-engine and the machinery which it worked. This was the part Webster could appreciate more fully than Jack, for the experience of the latter was almost entirely limited to the work of portable steam threshing machinery, although he could see the great convenience of the work done by the fixed machinery. Webster, on the other hand, looked at it with a more mechanical eye, and he was soon quite at home with the arrangement. At length Mr. Fergusson arrested their attention by saying it was time to go and see the cattle fed.

"I am very particular," said he, "about the feeding of my cattle, and I make my men and my cattle just as punctual as my clocks."

So saying, he entered the room in which their food had been prepared just as Tait was opening the door into the cattle shed. A small tramway was laid down the centre of the building, between a double row of fattening bullocks, and along this the supplies of food were going to be sent for distribution to the right and to the left. The opening of the door was the signal for the cattle to begin to arouse themselves from their sleepy rest, and take some more food. It was a sight of which Mr. Fergusson was justly proud, and which in fact he loved to see. On each side of the feeding path were twenty cattle, all of the black Polled Angus breed, and as level and promising as man need wish to own.

"These beasts, my boys," said Mr. Fergusson, "may teach you many useful lessons, for I can assure you they represent many an anxious thought, and much dearly bought experience. This is the number I fatten off every year, and I pride myself that the

meat is as good as any in the kingdom. I will tell you something about my management by and by, but whilst we are here we will look well about us, for when Tait has done he will see us all out without much ceremony. You will see every one of these beasts has a separate box for itself; in this respect I have not followed the example of my neighbours, but I see no reason to regret having these boxes (instead of hammels), for I am perfectly satisfied with the progress of the cattle, and the quality of the manure. I shall not be able to say, whilst we are here, half I want to tell you about these cattle, but take notice of two or three things. The air of the building you find fresh and good, although we have so many cattle here. Notice also that each animal always has the opportunity of drinking water, and that we give each a fresh and clean supply twice every day, and every beast has a lump of salt to lick whenever it pleases. The dung in these boxes is firm, and with a moderate supply of litter forms a perfectly comfortable bed for the cattle to rest upon. The cattle are all looking well, and are making good progress. I consider it to be of immense importance to insist upon regularity in the feeding time, and even in the order in which the beasts are fed. Notice also those four wooden boxes standing against the wall behind the cattle on both sides. You see they are about 6 feet in height from the ground, and they measure on the inside 18 inches by 6 inches. They are open at the top, and lead down to a brick flue which is connected with the boiler chimney. If we throw some small pieces of paper over them you see they are quietly drawn into the flue, and through these the impure air of the shed is constantly passing away. Let us now get back to the feeding passage, and beneath this you see openings through which the fresh air is admitted from another brick flue, so constructed as to deliver fresh air at several different points. Now then, we must be off, for Tait is coming to lock the door, and after eating their meal in peace the cattle will compose themselves until 8 o'clock, when they will have their supper."

"I noticed," said Jack, "that Tait was giving them meal; I wish you would tell me how you are feeding them, and why you do so."

The promise was cheerfully given, and as they were gathered around the fireside after their walk Mr. Fergusson told them, "I have long been satisfied in my own mind that there are three or four essentials to success in fattening cattle in sheds—good food, given with regularity; healthy air to breathe, a moderate supply of water, and the opportunity of taking salt. These are my landmarks, and the more I keep all these well in view the better I succeed. I speak simply as a farmer. I have never had the opportunity you young men have got of learning the cause of success or failure; but I have observed facts, and by these I have been guided. I used to give my beasts at one time their 2 cwt. of turnips daily, with good oat straw in the rack, and after a time I gave them 5 lb. of oilcake daily in addition. I thought I was giving them too much water in their food. I have now knocked off just half the turnips I used to give them, and I give some oil-cake and meal instead. I save 100 lb. of turnips daily on each beast, and I give in exchange 2 lb. of cake and 2 lb. of bean-meal, and after a time I shall increase the quantity of oilcake. I am convinced we often give fattening cattle too much water in their food."

"But," inquired Webster, "why do you give the cattle a constant supply of water? Are you not fearful of their taking too much?"

"There is no danger of that," replied Mr. Fergusson. "They only drink when they are thirsty, and when they are thirsty they ought to be able to drink. The supply of water I have provided, I look upon like the safety-valve of a steam boiler. If it is not wanted it does no harm, but when we go in for the use of dry food or simply moistened food, then we want to protect ourselves from accidents. A beast eating 2 cwt. of turnips regularly every day is not likely to want water, because it is already taking too

much, but when I reduce the quantity of turnips, and give some dry food instead, then I want this safety-valve. Do either of you know how much water there is in 2 cwt. of turnips?"

"About 90 per cent.," replied Jack, "and I will soon reckon that out. Well, say 200 lb. of water, or about 20 gallons."

"You see," continued Mr. Fergusson, "the enormous quantity of water given when roots are so largely used. Even now I am giving every day to each beast roots containing 10 gallons of water."

There were numerous subjects upon which Mr. Fergusson had to give the young men information before that interview ended. It was a treat to them to listen to the circumstances which had led Mr. Fergusson to improve his system of farm management. Nothing, however, more impressed them with surprise than the oft-expressed regret which Mr. Fergusson felt, that he had not had the advantage of some knowledge of science, to aid him in understanding with greater clearness the agencies he had to deal with, and the great value he set upon the opportunities they possessed in Rodney College. Before the time of their departure Webster inquired of Mr. Fergusson if he had any plans showing the arrangement of the steam machinery in the farm buildings.

"Oh, yes, I have," replied Mr. Fergusson, "and I have also plans of the buildings, and if you and your friend Holmes like to copy them, I will lend them to you."

It is almost needless to add that the offer was gratefully accepted, and long after the young men had returned to Rodney College, it was with no ordinary satisfaction that they looked back upon many incidents connected with their visit to the Lodge Farm.

CHAPTER XV.

THE COLLEGE FIRE BRIGADE.

AFTER the general work of the day had been entirely completed, the plans of the machinery and buildings at the Lodge Farm claimed the attention of the young men. For a time, at any rate, they had to discontinue their usual practice of adjourning to Webster's room after their work was completed, for the purpose of experimenting with his physical apparatus. Webster was by no means a stranger to the work of machine drawing, and was soon able to commence his copies of the plans. Acting under Webster's guidance, Jack soon got into the way of copying the plans of the buildings, and before long the walls of Jack's room were decorated with plans of the machinery and buildings at the Lodge Farm.

Every day brought its succession of duty, and the time was so fully occupied with lectures, class work, and the careful record of their revised notes, that what with excursions and museum work there was but little time left for them to dispose of for other purposes. Still the health of the students was not overlooked, for a good gymnasium and cricket ground gave opportunities for active exercise, which were very generally taken advantage of. At the same time some of the students had been formed into a fire brigade, and were regularly drilled. This had its advantages, for it facilitated a disciplined action on the part of the members, and enabled them to be utilised in cases of necessity. An incident happened in Rodney College at this time which afforded an example of this character.

The students had all retired to rest by 11 o'clock, and the gas

supplied to their rooms had been turned off, whilst in the corridors alone gas lights were burning. About 1 o'clock in the morning an alarm of fire was given by the hall porter, and it was soon discovered that the kitchens were burning somewhat furiously. Very little confusion however arose, for the College fire brigade was promptly brought to the front with their hoses, and "Extincteurs." Within ten minutes from the alarm being given, the fire, which had threatened the safety of the building, was reduced to a perfectly harmless condition. There was no change observable in the procedure of the College work on the following day, but it is probable there was not one of the students who did not see the especial value of the fire brigade drill, which they now looked upon with more than usual interest, particularly as regarded the use of the "Extincteurs."

As none of the students who had joined the College during the present session had been elected to the fire brigade, or had seen the "Extincteurs" used, further than as part of the movable apparatus of the fire brigade, it was arranged that at their next drill they should be shown in action upon fire. The "Extincteur" was first explained to the students by a lecture, but it may be briefly described as a light metallic vessel which can be easily carried on the back, which contains water in which some carbonate of soda is dissolved, and the vessel also contains a bottle of sulphuric acid, which is broken when the apparatus is going to be used. As soon as these bodies come in contact a strong effervescence takes place within the vessel, but the pressure of gas soon stops the effervescence, and the liquor becomes like soda-water in an unopened bottle. A flexible tube and tap enables the person carrying the vessel to send a stream of "effervescing soda-water" upon the fire, which is almost immediately extinguished by the carbonic acid it contains.

At the trial in question a cartload of cut timber, over which half a barrel of tar and a gallon of turpentine had been thrown, was set on fire. As soon as the fire was sufficiently strong to

drive persons away from it—say to a distance of four or five yards —one of the students, whose face and hands were properly protected, advanced to the fire and turned upon the burning mass the stream of liquor from his "Extincteur." A second student was ready with another "Extincteur" waiting orders to advance in case of need. The first "Extincteur" after it had been in action for two minutes, had very greatly reduced the fire but had not extinguished it. The second was then advanced, and in another half-minute the work was completed.

"Well," said Jack, "who would have expected such a control over fire? How many a fire in farmhouses could be stopped at once if these 'Extincteurs' were more generally kept. I will certainly make a present of one of them to the good folk at home as soon as I can spare the money, and show them a new use for effervescing soda-water."

Jack's life in College was necessarily one of great regularity, for being a hard and steady worker, and having in his friend Webster one of congenial spirit, it was very rarely that their regular routine was broken in upon. Their second monthly examination was now past, and their good work made itself manifest by their positions in their several classes.

This was immediately followed by the second College conversazione, and the subject for the evening was the "variation in the weight of flesh produced by food, according to its mode of use." It was introduced by Mr. Bennett, one of the senior students, and he noticed the advantages arising from proper shelter as a means for economising the use of food, and the advisability of giving food with regularity, steadily increasing the allowance of food as the animal progressed; in fact, keeping the animal making flesh as rapidly as was consistent with its health. He exposed the policy of keeping an animal without providing for its making some improvement in its condition, as a waste of power which ought to be properly utilised. He showed that a person being at the expense of keeping an animal in a condition to make meat,

and not letting it have the food necessary to form that meat, was like one who kept a steam engine running without giving it any work to do. The costs were incurred, but no advantage was gained, because there was no material supplied for manufacture.

His paper was received with much satisfaction, and an active discussion followed. It remained, however, for the Principal, by a careful examination of the actual facts which had been brought forward, to point out the circumstances which were really influential in causing the differences which had been named. In many respects he was successful in his efforts, but in other cases no one was more ready than he to admit, that the principles regulating agricultural practice were at best but very partially known, and that discussions and researches based upon the results of careful trials, would do much towards making those principles better known, and also of greater value.

With the following day commenced the last month of the term. Jack and Webster worked harder than ever, each acting as "coach" to the other; but it had its satisfaction, for on a re-perusal of the work done, each found that the other had made considerable progress since they had gone over the ground in the first instance. They had, however, to pass under the searching examinations of their professors and tutors, and when the result was declared, Jack had the satisfaction of knowing that he had made good progress in his lecture classes, and that he was qualified to leave the tutor's classes upon physics, botany, and vegetable physiology, but he had still to remain in the tutor's classes for other subjects.

The term had not been quite three months in length, and the days had flown with surprising rapidity, but still each appeared to have travelled a long distance over his new journey. Both looked forward with pleasure to the approaching short vacation, which was likely to refresh them for a renewal of their work, more especially as Jack—in consequence of his distance from his home—had accepted an invitation to spend his Christmas with Webster in Edinburgh.

CHAPTER XVI.

THE EXAMINATIONS.

THE winter vacation did not long delay the College instruction, and Jack was soon engaged again in steady work. In addition to his tutor's classes, his preliminary course upon the principles of agriculture, as well as his instruction upon chemistry and mensuration, were progressing; and he was becoming familiar with practical work in the laboratory. He had now to commence the lectures upon vegetable physiology. Under a well-arranged system this gave him a fair amount of work, but nothing excessive, and he soon found himself settled into a routine of duty with which he was fully satisfied. The apparent delay consequent upon his preliminary class work soon began to yield its reward by the rapid progress Jack made in his studies.

He noticed that the Principal always addressed his class in language of the simplest possible character, so as to carry to the mind of each pupil the instruction he sought to impart; but he also made a rule of testing the accuracy of the impressions they received, by an examination prior to each lecture upon the work previously done. Any doubt upon the minds of his pupils, or any errors were thus detected, and the examination went far towards impressing the subject permanently upon the memory. It was not sufficient for him simply to deliver a course of lectures, and at the expiration of the course, or a certain portion of it, to rely upon a written examination, even when supplemented by a vivâ voce examination. It was a rule with him to satisfy himself that thoroughly sound work was being done. Some thought that it lowered the dignity of a lecturer to adopt such a course of

procedure, but the Principal supported the practice by his example, and in this he was entirely guided by a desire to secure the most successful teaching. Others gave the practice their unqualified approval, and looked forward with confidence to a more general adoption of the system.

The incidents of a College life when the students are a set of workers, are by no means as amusing as they are satisfactory. In Rodney College, much of the romance which commonly arises from those who are indifferent to work, was singularly deficient. It was pre-eminently a place for work, but with full opportunities for healthy recreation; this, however, was kept in its proper subordinate position. It was the tutor's classes which were so distasteful to those who hated work. The annoyance of having to attend such class instruction every day from seven to eight in the morning, and again in the evening, with subject-matter to learn in the interim, was too much for their peace of mind. The system very generally led to the retirement of idle pupils from the College, when a knowledge of the system had not prevented their entrance. The general result was good, and the students as a body were recognised as "a working set."

As month after month flew past, the examinations and the conversaziones became as milestones on the road, on which the students could as a rule, rest the eye in passing with feelings of satisfaction. Such was certainly the case with Jack and his friend Webster—they had their difficulties and their differences—but they worked well together, and were mutual helpers in their studies. At the end of his second term Jack had qualified himself in mensuration and book-keeping—he received his pass certificates for these—and took up mechanics and architectural drawing instead. He had also progressed sufficiently in his tutor's class for animal physiology, to be ready for attending the lectures upon comparative anatomy and physiology, which were to be delivered during the following term.

After a few days' vacation at Easter, Jack was progressing with

his work "like a ship in full sail, with a fair breeze." He had three lectures to attend daily, and three of the afternoons in the week were engaged for laboratory practice, museum work, and drawing. His time was thoroughly well occupied, but there was no undue pressure, for although he was working hard, still there was nothing excessive about it. He was making thoroughly good progress, in common with his fellow-students, and they continued so to do until the lectures and instruction were stopped for the examination upon the year's work.

It may be well at this stage to review the work Jack had accomplished in his first year's course of study. He had attended full courses of lectures upon inorganic and organic chemistry, as well as upon physics, extending through the session from October to June. He had also taken the preliminary course upon the principles of agriculture, together with practical instruction in the chemical laboratory, for the same period of time. He had passed through his instruction in mensuration, and gone through his instruction in mechanics. He had qualified in book-keeping and was progressing in his instruction in architectural drawing. In the period extending from January to June he had also taken his lectures upon animal and vegetable physiology.

It was an important part of the system of education pursued in Rodney College to give the students the best possible opportunity of being trained in pure science during the first year's course of instruction, in order that they might the more fully devote themselves afterwards to the application of these sciences to the practice of agriculture. The arrangements secured, for pupils with fair ability and proper industry, a successful attainment of these results. Jack and his friend Webster were amongst those who secured their certificates in pure science; in fact, the great majority of the students gave proof that they had duly qualified themselves for these pass certificates. Those students who failed to pass in one or more of their subjects had the opportunity of attending instruction in the following year upon those subjects,

so that they might qualify themselves for subsequent examinations. These pass certificates were really so many vouchers for work accomplished, and they gave evidence of the industry and ability each student had brought to bear upon his studies.

There is a striking difference in the condition of mind with which students approach an examination, and there are two conditions which materially influence the results.

First. Such an acquaintance with the subject as shall justify success; and

Secondly. Such experience in undergoing examinations as shall accustom the pupil to give clear proof of the knowledge he possesses.

The policy at Rodney College kept both of these points steadily in view, for it was recognised that weakness in either of these conditions was sufficient to endanger success in examination.

It is readily admitted that there is just cause for the outcry which has been made against "over-examination and cram," but these are easily distinguishable from the course of procedure followed in Rodney College. Examinations in the principal classes were seen to be as instructive as the lectures on which those searching inquiries were based. So long as examinations are made use of as a means of instruction, they are unquestionably valuable, for they not only test the accuracy of the knowledge actually acquired, but they often suggest new lines of thought to the student, leading him thereby to a more perfect acquaintance with the subjects he studies. It is when the examining body becomes distinct from, and independent of, the teaching body that the evils of "over-examination and cram" are liable to commence. It must be admitted that there are examinations which not only encourage "cram," but actually necessitate its adoption—such for example as when a pupil has to be examined in too large a series of subjects at the same examination. These examinations test the student's power of "cram and endurance"

rather than his attainments in the several subjects. The system at Rodney College, on the other hand, insured sound and substantial work, day by day, and the more fully the students were examined, the better was the evidence they gave of the firmness and utility of the work.

CHAPTER XVII.

VACATION PLEASURES.

THE results of Jack's first year in Rodney College were a source of much satisfaction to his mind, and he welcomed the long summer vacation with unmixed pleasure. He had had a long and steady pull at his studies, the results were most satisfactory, and his prospect of a return home was surrounded with many bright anticipations. As Webster had had very limited opportunities of taking part in farm work, arrangements had been made for him to return with Jack, and spend the greater part of his vacation with him, in seeing something of the practice of farming in the neighbourhood of Wrexborough. After a few days' stay in Edinburgh the two young men were journeying southwards, and a hearty welcome from Mr. and Mrs. Holmes awaited them on their arrival at the Holt Farm.

It will be readily understood with what pleasure Jack took his friend on the following day over their farm, and the hearty manner in which the labourers welcomed him after his long absence. George Moore, the shepherd, had much to tell Jack respecting the progress of the flock, for he still looked upon Jack as his helper in his work, and one in whom he had the greater interest because he had trained him in its management. The Squire had not yet returned from London, but in his absence Jack called on the next day upon Mr. Thompson, his steward, showed him the certificates he had gained, and asked him to report the same to Mr. Woodford. At the same time he desired to convey an expression of his sincere thanks for Mr. Woodford's

kindness whereby he had been enabled to attend to his studies in Rodney College.

"Well, Jack," said Mr. Thompson, "you will not go back alone, for we have just heard of the Squire's second scholarship being awarded to young Tom Hughes of the Forest Farm. I may tell you that the Squire wrote to the Principal to know how you were progressing, and upon receiving his reply he decided to give a second scholarship to the Wrexborough class, and I am pleased to see it taken by the son of one of our tenants. And what do you think of our experiments on roots this year?"

Jack was bound to confess that he had not as yet had time to inquire about them. Mr. Thompson was quite content to leave him to learn the particulars from his father. Jack then rode over to Wrexborough to see Mr. Nicholson, and to report to him the progress he had made. Both, however, had so much to say to each other, that much was unavoidably held in reserve until Mr. Nicholson could come over to the Holt Farm; but this was fixed for an early date.

According to previous arrangement Webster came under Mr. Holmes' care in Jack's absence, and the question very naturally arose between them as to Webster's best plan of procedure to take full advantage of his visit for acquainting himself with farm work. It was arranged that for the present he should help the shepherd, keeping his hours regularly, and taking share in his work.

On Jack's return home one of his first inquiries was as to the root crop experiments. Holmes explained that the arrangement of the previous year still held good, for the Squire had expressed a wish that Mr. Nicholson and his steward should continue to work with him in their management. The various trials of the previous year had been exceedingly useful in many respects, and, as far as they could judge, the crops had been obtained of decidedly higher feeding character, and with better keeping properties. This year it had been decided to repeat the manure

experiments of the previous year, but to take care that the same growths of swede seed were used throughout the series. They were also testing the influence of using 1 and 2-year-old seed upon the quality of the produce. They had been led to adopt this course because it had been noticed that 2-year-old seed was firmer and more steady in its growth, and therefore less liable to be checked in its growth, producing thereby mildewed crops. One-year-old seed, on the other hand, made more rapid progress, and was predisposed to a "necky" growth, and "to run to seed," especially when they used stimulating manures. Mr. Nicholson had led them to expect that this more vigorous growth of the 1-year-old seed might be useful in some cases, especially when they were using the manure in a slowly soluble condition, whereas it increased the danger to the crop when such seed was used with manure of a very soluble character. In such cases the manure and the seed both encouraged rapidity of growth. The views Mr. Nicholson had previously pressed upon them, as to the desirability of securing a steady and uninterrupted growth until the cells of the plant had been well filled with food, had been quite accepted in that neighbourhood as the right and proper course for adoption. The experiments of the previous year practically settled the correctness of that system in a manner they were not likely to forget; and the trials of the present season were intended to be in general a repetition, with the provisions named as to the seed.

Mr. and Mrs. Holmes were pleased to hear of Mr. Nicholson's intended visit, and to make the party more complete, Mr. and Mrs. Forbes and Dr. Whichcord were also invited. Many a day had passed, and many a change had taken place since their previous gathering. The two ladies were then hostile to science instruction as a part of female education, and were only brought to recognize its advantages by their own acknowledged difficulties. Mr. Holmes and Jack both looked forward to the meeting with much interest, for science had been well patronised by some of

them since that day, and its advantages could no longer be disavowed. The two ladies had attended Mr. Nicholson's lectures for one season, and their example had led many others to go, so that, as a matter of fact, there were in that neighbourhood a fair sprinkling of men, women, and boys who were not ashamed to acknowledge that they were endeavouring to learn more of the why and the wherefore of the duties of everyday life.

In the course of a few days they all met at the Holt Farm. Hearty congratulations were given to Jack on the work he had done, and especially by Mrs. Forbes.

"I have been hoping for your return," she said, "for my difficulties are as great as ever with the 'blowing' of my cheeses; and now that you have got on so far in chemistry, you will be able to help me."

"I fear," said Jack, "that, for the present at any rate, I can give you little or no help. The work I have been doing has really been only a preparation for learning something of a higher and more practical character. When I have made more progress I shall be happy to give you any help in my power; but I am more than ever conscious of how much I have yet to learn."

"I am really glad to hear you speak with so much proper feeling, Jack," said Dr. Whichcord. "I hate to hear a young fellow who has just got hold of some little science speaking as dogmatically as if he knew all about the subject. Mrs. Forbes' difficulty will puzzle wiser heads than yours, Jack, before we understand all about it. Don't you think so, Mr. Nicholson? By-the-bye, how is your friend Robinson, who knew so much about phosphates that he could only speak of them in what he was pleased to call proper chemical language?"

Mr. Nicholson satisfied the Doctor as to the welfare of his friend Charlie Robinson, and thoroughly agreed with him respecting the cheese difficulty.

"You will probably laugh at me," said Mrs. Forbes, "but I am disposed to think that the artificial manure put upon the grass

affects the quality of the curd of milk. Mr. Nicholson told us in one of his lectures that we could increase the quantity of curd by means of manure, and if it can do this, why should not the manure also affect the quality?"

"I quite agree with you, Mrs. Forbes," said Mr. Nicholson, "but it wants careful research to discover the full truth on this point, for it must be remembered that if it can be shown that manures affect the cheese injuriously, there is no reason why we should not find some other form of manure to influence it advantageously. We have, therefore, a double object to gain, and if you can only wait for another year it will be a very nice subject for us to work upon when Jack has finished his studies at College."

Mrs. Holmes then inquired of Mr. Nicholson whether he remembered telling the pupils of his class about the waste arising in the salting of pork? adding a request that he would tell them how the loss should have been avoided, "for you must remember," she said, "that the pork had to be salted to keep it good."

To this Mr. Nicholson replied, "Some few years since, an investigation was carried out by a friend of mine, in which he examined the various methods adopted for salting meat. The conclusion he arrived at was, that for the preservation of meat it was absolutely necessary to act upon the juices present in the meat. In those cases in which the digestible character had been diminished as little as possible, it was accomplished by the use of bodies in some degree capable of replacing those removed in the juice drawn from the meat. The use of saltpetre or nitre with the salt, had the effect of decreasing the extractive influence of the salt by its astringent action upon the flesh, and by the aid of the potash it contained, the colour of the meat was preserved. Liebig had pointed out that the presence of magnesia and lime in the juice of meat favoured its easy digestion, hence was seen the advantage of using bay salt, which contained both of these mate-

rials, and it showed why so small a proportion of bay salt was necessary. It was at one time a common practice in America to preserve meat without the use either of salt or bay salt, but they accomplished their object by the use of wood ashes, which all here know contain potash, lime, and magnesia, and thus all the necessary materials were still supplied. If salt be added to meat without the saltpetre, the juices are drawn out to an unnecessary degree, and the meat becomes hard and indigestible, but if they went to the opposite extreme they found that too much saltpetre produced equally objectionable results. Nor must you overlook the action of sugar upon the albumen present in the meat; but time prevents more than its mention. You ladies must endeavour so to modify your plans that the meat may be preserved with as little injury as possible to the nutriment it contains, and without sacrificing its digestible character."

When Mr. Nicholson had made his reply, Jack took the opportunity of securing him for his own especial benefit. They thus had the chance both so much desired of talking over the position of affairs in Rodney College, and Jack's general prospects there, whilst the other members of their party entertained themselves independently of them.

CHAPTER XVIII.

ADVANCED STUDIES.

WITHIN a week of the time of Jack's return home, he received from Mr. Woodford a letter of congratulation, expressing the feelings of satisfaction with which he regarded the establishment of the scholarship which Jack held, accompanied by a few words of encouragement, and hopes for his future success in life. Jack, in showing the letter to his father, remarked, "I have striven hard in the past to merit his confidence, and henceforth, I shall do all I can to show myself worthy of it, so now, Webster, I am in for farm work again until harvest is well over."

Webster had his month with the shepherd, and would not allow any excuse to tempt him from his work; but Mr. Holmes then thought he had better make a change and help with the horses. Tom Baylis was in no way unwilling to have him as his helper, and when the harvest work began he put him so as to work—change and change about—with Jack. The harvest that year was finished rather early, and immediately after the harvest supper, Webster proceeded to Edinburgh to spend a week or so with his mother and sisters before he entered upon his work for another session. Jack, accompanied by young Tom Hughes, followed shortly after, in time for the opening day at Rodney College. The journey from Wrexborough gave Jack a full opportunity for informing Tom Hughes as to the general course of procedure in the College, and advising him upon many matters calculated to promote his success.

Bright and happy was the gathering of the senior students of the College—for as such Jack and Webster now ranked—and the

cheerful spirit in some degree extended itself to the junior students; in fact, it seemed as if it were the prevailing atmosphere of the institution. Jack found his new work materially different from that of the previous session. Generally speaking the past teaching had been arranged so as to serve as preparatory to something more advanced, and more obviously associated with agriculture. The preliminary instruction in the principles of agriculture glided the student almost imperceptibly into the more advanced subjects which had to be dealt with in the future lectures. The instruction in organic and inorganic chemistry, formed a natural foundation for the course of lectures upon chemistry in its applications to agriculture. The laboratory work presented simply a continuance of the practical operations in which Jack had already made considerable progress. His previous instruction in mensuration laid the foundation for a knowledge of land surveying. So also did the progress made in mechanics and physics give a suitable preparation for a study of the steam engine. The studies in natural history, which dealt with the varying conditions of animal and vegetable life, formed a convenient preparation for those geological studies, in which the characteristics of the various formations were so largely determined by the fossiled remains of animals, and of a vegetation, belonging to earlier periods of time. In like manner the study of animal physiology and comparative anatomy prepared the student's mind for the study of veterinary surgery, and the practical application of the laws which regulate health and disease. Finally all tended towards a complete preparation for understanding the variations in the practice of agriculture, the requirements of rural economy, and the successful management of landed property.

The subjects which had to be dealt with in the second year constituted, at first sight, a rather formidable array of work, but by good systematic arrangements, and with a reasonable amount of diligent attention on the part of the staff and the senior students, there was nothing to discourage a fair worker.

The senior students were almost entirely second-year's men, for, in addition to those who came from other science colleges, for higher instruction in applied science, there were only a few of the students of the previous year, who had failed to pass in some of their classes. As the latter held their certificates for some of the subjects, they only wanted to attend the lectures upon the subjects in which they had failed. There was no material variation from the system pursued in the previous session, although the subjects and the times had necessarily been altered. The lectures upon chemistry in its application to agriculture contained little that was new to Jack. Still it was a subject of such great importance that he listened to them with great attention. No one who knew Professor Maynard could doubt his great ability as a chemist, nor fail to be pleased with his happy mode of conveying that knowledge to his pupils; but he knew perfectly well that when he had to deal with the applications of chemistry to an occupation with which he was not acquainted, there was need for the greatest caution. Jack was much struck by Professor Maynard saying to them, at the commencement of his present course of lectures:—"Chemistry I know, but agriculture I do not profess to know. It is, however, my duty to blend these two subjects as perfectly as I am able; but when speaking from an agricultural point of view, you must not understand me to speak dogmatically, but rather suggestively."

The students admired the man who did not claim credit for a knowledge he did not possess, for no one was more ready than he to acknowledge the importance of any teacher who sought to blend two branches of knowledge, being acquainted with both subjects.

Amongst a body of young men such as were resident in Rodney College, differences of opinion frequently arose, and these matters often ended in warm discussions amongst the students, and in some cases in an appeal to the Principal. A somewhat lengthened discussion had taken place between them as to the difference

between agricultural chemistry and the principles of agriculture, which could not be settled without such a reference, and Dr. Thomson was asked to point out the real distinction. He said—

"So far as chemistry explains the reason why the practices of the farmer are more or less successful under certain given circumstances, so far such agricultural chemistry is really one section—we will say the chemical section—of the principles of agriculture. Each branch of science you study in this College has some connection with agriculture, and each of these contributes its quota towards the general scope embodied in the term the principles of agriculture. As you, the students of this College, having first acquired a good knowledge of the sciences, add to it an intimate acquaintance with farm practice—as, in fact, you become experienced farmers—so we may fairly expect that you will become contributors to these principles of agriculture. Each branch of science, not chemistry alone, renders its quota to our general knowledge, not one science being excluded from its fair share in the work; and, just as you become "good all-round" men at science, so will the lessons you learn from agricultural practice represent well-matured opinions upon the principles of agriculture."

Jack was very pleased to observe that the example set by the Principal—of proving by vivâ voce examinations that the knowledge his class had gathered from his preceding lectures was satisfactory—had been adopted by some of the other professors. As a pupil he felt its use, and he recognized it as a great security for an accurate acquaintance with the subjects of the lectures. As Jack familiarly described it, "It makes sound work, for the nails are clenched as the work proceeds."

The subjects taught by the Professor of Veterinary Surgery were exceedingly interesting to Jack, and he looked forward to the general scope of the work indicated with intense satisfaction. His instruction in animal physiology had awakened in his mind a thirst

for a fuller acquaintance with the laws regulating the health and the reproduction of farm stock. He saw that the farmer's success largely depended upon the care taken to keep within the landmarks which bounded the region of health, and thus prevent the necessity for resorting to veterinary science to correct errors which should not have been committed. Two lectures, and one afternoon weekly at the hospital, gave him opportunities for progress in which he rejoiced. He well remembered the practical lesson he had learnt from their shepherd at the Holt Farm, when he wanted some of the exhibition ewes to be bought for that farm. He had never seen the reason why, for this and for many of the other lessons he had been taught upon their farm, which were evidently true as being the results of long experience. He saw, however, that his present instruction took him behind the scenes, and instead of being content with watching the puppet, he now expected to see how the wires were pulled which put it into motion.

CHAPTER XIX.

AN AMERICAN FRIEND.

THE session had not far advanced when the Principal informed Jack that he would like him, as one of the senior students, to introduce one of the subjects at a college conversazione. He had made arrangements for the first, but he hoped Jack would be ready for the second. Jack hesitated to undertake the responsibility, but the proffered aid of the Principal, and his promise to look at the paper prepared for the meeting, encouraged him to undertake the duty. The first conversazione had arrived before Jack had settled in his own mind what subject he would select. At this conversazione Mr. Fergusson was present, so Jack told him of his position, and with a few encouraging remarks from him Jack's nerves got into better condition. The great difficulty still remained —viz., what subject should he take?

"Why not show the necessity for proper ventilation in cattle sheds?" inquired Mr. Fergusson. "We talked this subject over when you were at the Lodge Farm, and you no doubt recollect what we are doing there. If your memory wants refreshing, come up again, and bring Webster with you."

Practically this settled the matter, and forthwith other subjects occupied their attention.

On the following day, as Jack was leaving one of his lectures, a card was placed in his hands, with a message, saying the gentleman was desirous of seeing him. Jack proceeded to the library, and recognised in the visitor the American gentleman with whom he had travelled in his first journey to Rodney College. After some little conversation, he expressed a desire to be introduced

to the Principal and to inspect the College. Jack cheerfully conveyed his wishes to Dr. Thomson, who gave him a courteous reception and an opportunity of informing himself respecting the College arrangements and the system of education.

"For a British college," said he, "you are very good indeed, but you must take some steps in advance before you will equal our State colleges, and you have also some important lessons to learn from Continental colleges. Since I travelled in this direction with my young friend here, I have been over much of the Continent, but I was so interested in the young fellow, that I turned out of my way to see him and to visit Rodney College, which I am bound to say I heard spoken of in France and Germany in very high terms. You will excuse me, I hope, if I venture to say that until such institutions as these devote time and attention to original research, you will never occupy the useful position you ought to hold. In the staff of professors for such a college you ought to have a body of men pre-eminently qualified for this description of work; and, without prejudice, I would add that such additional duties would tend to make them more intimately acquainted with agricultural practice. Your College should become the central institute for a district, and the farmers of that district would cheerfully co-operate with your staff in the growth of agricultural produce under the special conditions they desired. Consider, sir, the interest this sort of work would create in the minds of your students, and the economic advantages which would result to the district."

The Principal readily admitted the truth of the appeal, and thanked him for his suggestions, in the advantages of which he fully agreed with him.

"As you have received my suggestion so kindly," he continued, "let me also take the opportunity of mentioning what strikes me as a very extraordinary oversight in the agricultural system of your country; and that is in so greatly neglecting researches upon entomology and the lower forms of vegetable life, in their eco-

nomic relations to agriculture. We have the powers of insect life urgently forced upon us in America, and we cannot neglect this influence if we would, but in the British Isles you appear to me to suffer considerable losses with calm indifference. A serious loss of crop arises, and you attribute it with characteristic coolness to 'blight or something of that kind,' and you accept the loss as if it were inevitable. These little enemies of the farmer seem to be beneath his notice, and what is equally serious, is that you do not attempt to distinguish between these enemies, and those friendly allies which would exterminate them. We have been compelled to watch these matters in the States because they very seriously affect our profits, and we have our regular State entomologists who are paid to look into these matters. Let me beg of you to encourage your students to look into these matters. I am now returning to the States, and with all your imperfections at Rodney College, I shall still carry back with me many pleasing recollections of my visit and of your courteous reception, for which I thank you. Good-bye, my young friend. Go on and prosper. Here is my address, and I hope that I shall some day hear from you."

It was a hasty visit, but neither the Principal nor Jack for a moment regretted the somewhat singular interview. As Jack progressed with his veterinary studies and hospital work, so did he become more and more interested in the subject. Professor Armstrong felt very strongly the importance of thoroughly good anatomical work, not only to familiarise the students with the structure of the body, but also to make them the better acquainted with the functions to be discharged by the various organs of the body. A study of the laws of health he represented to be of very great importance, because "prevention is better than cure," and he wanted them to see how to keep the fountain pure, rather than how they ought to purify the stream which had been polluted by neglect or bad management.

Jack was equally interested in the lectures upon the principles

of agriculture, for these often presented some curious blendings of various branches of science with the experience of practice. In listening to the lectures upon dairy management, Jack could not forget some of the homely discussions he had previously enjoyed on this subject. He listened attentively to the details of that watchful care and good management by which the flow of milk could be encouraged and rendered a more settled point of character—the circumstances which influenced the size and character of the milk globules—and the practical influence thereby exerted on the manufacture of butter and cheese. Another point which particularly arrested Jack's attention was the production in milk of a strong smelling oil—and when separated quite a fœtid oil—which was rendered more observable when the milk had been closely covered up for some hours, or when the milk had been sent by railway in close vessels. It was shown that when this rank oil is carried into the curd, it favoured a putrefactive change in the cheese, and interfered with its proper ripening. This oil appeared to be formed in increased quantity when the cows drank stagnant water, or partook of improper food, or were kept in an unwholesome atmosphere. Jack, who had not forgotten his arrangement with Mrs. Forbes, made himself well acquainted with these and many similar matters.

The evening for the conversazione at length arrived, and after the usual preliminaries of the meeting had taken place, Mr. John Holmes was called upon for his paper upon "The Necessity for the Proper Ventilation of Cattle Sheds." He commenced his paper by referring to the desirability of warm and comfortable shedding for cattle as a means for economising the use of food, and proceeded to show in detail that there were two systems adopted in practice for keeping animals warm, but the one plan was calculated to promote disease whilst the other was favourable to the health of the body. He showed that heat was thrown off from the body, and this was often preserved with great care as a means for promoting the animal's comfort; but

with this heat there were impure air and offensive exhalations, which interfered with the health of the animal. He then went on to show that when an animal was judiciously fed, the heat-producing matter of the food, when supplemented by a proper supply of fresh air, gave a warmth which favoured the healthy condition of the body. It was the especial duty of ventilation to carry away the impurities which passed from the animal into the atmosphere, just as we take care to convey away the smoke produced by our fires.

"Hence," he said, "whilst economy of warmth is desirable, it should not be gained by a sacrifice in the purity of the atmosphere of the building. It is not simply an optional matter whether fresh air shall, or shall not, be supplied. If the supply be not given, death takes place; if it be given in too small a proportion, diseases of the lungs and bronchial tubes are established; but a free and bountiful supply of air is essential for health."

When he proceeded to show how this object could be best attained, he mentioned the various difficulties with which Mr. Fergusson had to contend before he succeeded by the arrangements now adopted at the Lodge Farm. They had found the system of ventilating through the roof very far from satisfactory, for the hot air as it reached the roof, became cooled, and descended with all its impurities "cooled" it must be admitted, but by no means "fresh." Mr. Fergusson, he explained, supplemented these roof ventilators, so that through the winter months they took advantage of the fire of the engine-boiler, and by means of an underground flue the impure air was constantly passing from the shed to the chimney. A supply of air had been provided from another underground flue running under the feeding passage (as already described). At such times the ventilators in the roof were closed. By this system fresh air was admitted at the heads of the cattle, and there was a quiet passage of air towards the walls behind the beasts, drawing away any impurities thrown into the air. He further showed that the food which the animal con-

sumed was like coal in another respect, for it also needed for its combustion a similar supply of fresh air. Altogether Jack's paper was a decided success, and with the discussion which followed, helped to render that College conversazione alike pleasant and instructive.

The remainder of the term soon passed away, and then Jack went off with his friend to spend another short Christmas vacation with Mrs. Webster in Edinburgh. It would be hard to determine which of the two young men most thoroughly enjoyed these intervals of rest.

CHAPTER XX.

COMPLETION OF COLLEGE STUDIES.

THE Christmas vacation flew with the proverbial speed of time pleasantly spent, and the work was quickly resumed in right good earnest. The steady daily work was now telling well upon the several courses of instruction in which they were engaged. There was that internal conviction of knowledge acquired, which gave a confidence to the mind that their acquaintance with their subjects was sound, and would bear the test of any fair examination. At the end of the second term Jack and Webster both passed their final examinations in the principles of agriculture, agricultural chemistry, laboratory work, and in land surveying, receiving the respective certificates.

The very brief Easter vacation was passed by both in the College, and it was with no ordinary satisfaction that they saw their work approaching its completion. The studies in geology and veterinary science were proceeding thoroughly well. As the instruction had now ended in the chemical laboratory, the time usually given to this work had to be devoted during this, their last term, to instruction in microscopic analysis. In his course of study upon animal and vegetable physiology Jack had become tolerably expert in the general use of the microscope, and rapid progress was consequently made under Professor Richards' instruction in the examination of farm produce, for the determination of more or less perfect conditions of growth, and for the detection of various adulterations in purchased goods. The course of lectures on the steam engine secured the warmest

interest from both Jack and Webster, and they were making good progress in the subject.

The time usually devoted to lectures upon the principles of agriculture, was now given to the broader subject of rural economy, and the duties of the estate agent. It was no part of the system adopted at Rodney College to give instruction in the practice of agriculture and kindred duties, but rather to prepare the students for learning it more perfectly—where alone it can be properly learnt—from the daily work of the farm. In dealing with the principles of agriculture and rural economy, much practical information was necessarily conveyed in showing the principles upon which the various practices were based. This system, however, stood out in striking contrast to the plan of giving lectures upon the practice of agriculture—crowded with details—from which the student was left to deduce, by his own ingenuity, the lessons they teach.

The second year's course of study was now rapidly approaching its conclusion, and the examinations soon gave proof of the results arising from the combined work of the professorial staff and the students. Jack and Webster passed in their remaining subjects, obtained their certificates, and were entitled to the science certificate of the College. In fact, the greater portion of the senior students were equally successful. This was the ordinary result of fair diligence in study by young men of good natural ability. Undoubtedly it needed two other conditions to make the result possible, viz., a good system of instruction, together with competent and diligent teachers, for without these no amount of hard study on the part of the students could establish the required success. It is true, some of the students from their own want of industry and ability failed to attain a full success, but a decided majority accomplished their work. Those who failed to secure their certificates, were recognised as having failed to accomplish what they ought to have done, and consequently such failures carried more or less personal discredit.

The hour at length arrived when the work of the session, being completed, the students who had gained the College Science Certificate were summoned to meet the Principal and the professorial staff.

The Principal said, "In handing to you the Science Certificates of this College I may remind you that you have still to qualify yourselves in the practice of agriculture before you can be allowed to rank as members of this College, and entitled to the College Diploma. A period of not less than two years must be devoted to the study of practical agriculture upon the farm. You will, I doubt not, find the course of study you have undergone in this College, a valuable preparation for acquiring a good knowledge of farm management. At the end of two years you will be eligible for examination in the practice of agriculture, and you will have opportunities for showing special excellence in any branch of husbandry you may select. But I need not go further into these details, as I hope that you, like most of our old students, will keep up a correspondence with the College. We shall be most happy to help you in any difficulties you encounter, and will only ask in return that you will inform us of any interesting facts which may come under your notice. One word of advice I may give you. During your stay in this College you have had the opportunity of seeing regularly the various agricultural papers published at home and abroad. I hope that this opportunity of itself will have led you to appreciate the value of these publications, and that after leaving here you will each take in one of these papers. Without some such means you will be unable to learn many new applications of the principles of agriculture—many new modes of practice which must arise—and which are daily noted in the columns of such periodicals. And when the time comes when we shall welcome you as duly qualified members of Rodney College—when your instruction in 'science and practice' shall have been satisfactorily blended—then I am sure you will well

maintain the honour of the title M.R.C.* by contributing to our knowledge of agricultural science, and by promoting the welfare of that great national industry in which we are all so deeply interested."

It was with many a feeling of regret that Jack and Webster prepared to leave a scene which had become endeared to them by many pleasing associations. In taking his private farewell of the Principal, he informed Jack that, "acting upon the suggestion of your American friend, the Council has authorised me to make arrangements for carrying out some original researches in agricultural science; and as this will throw much additional duty upon Professor Maynard, we have decided to establish an independent chair for agricultural chemistry; and you will be pleased to hear that your friend Mr. Nicholson has accepted that professorship in this College."

At length Jack and Webster are fairly started from Rodney College, and as it had been arranged that Jack should spend some few days in Edinburgh before proceeding southwards, Tom Hughes returned without his travelling companion. He had, however, the satisfaction of conveying a good report, not only of Jack's work and Mr. Nicholson's appointment, but very satisfactory evidence of his own proceedings.

The two young men were heartily welcomed on their arrival by Mrs. Webster and her daughters. They were proud of young Webster's success, and were pleased to see his friend equally distinguished. Shortly after their arrival Mrs. Webster inquired,

"And now, Mr. Holmes, now that you have finished your College work, what are you going to do? I cannot make

* We understand that some of the older students of this College, considering its full title to be the Rodney Agricultural College, designated themselves as M.R.A.C. It is needless to say this was a practice strongly condemned by the authorities, who insisted that the proper title was M.R.C., and took care that nothing in any of the diplomas should conflict with this.

up my mind what course I had better follow for my son's advantage."

"I shall return to my Father's farm," said Jack, "and learn the business of farming as thoroughly as I can; and if I were to suggest anything for Charlie, I should say, send him with some good farmer in the South for a year, and after that let him take a second year with another good farmer in Scotland."

"That is a very good proposal," said Mrs. Webster, "and it has much to recommend it, but the great difficulty with me is to find the right people to put him with."

Here the conversation dropped, and other matters occupied their attention; but at breakfast on the following day the subject was unexpectedly resumed by Mrs. Webster's second daughter—a bright young girl of eighteen—saying:

"Mamma, I have discovered a way out of your difficulty about Charlie. Let him go to the Holt Farm with Mr. Holmes for one year, and then you send them both down into the East Lothians for the following year. I do not think either of them would like to break the nice friendship they have formed."

"A capital idea, Janet," shouted young Webster, "and if the Mater agrees to it, I do."

It needed but little to be said about a proposal which seemed to get over so many difficulties, and, before the breakfast was ended, it had been arranged that Mr. Holmes should be written to. He saw at once that the proposal had many advantages for his son, and promised to secure for him a more complete instruction in farming than he had expected to give him, and he cheerfully concurred in the arrangement. The last doubts were removed when Mrs. Webster received Mr. Holmes' reply, but it necessitated a delay in Jack's return home if he were to be accompanied by Webster. Jack, it appeared had very little hesitation in meeting the wishes expressed, for both he and his friend were fully prepared to take a little rest and enjoyment under the happy circumstances in which they were placed.

Shortly after this Jack returned to the Holt Farm in company with his friend Webster, but amongst the many congratulations he received on the completion of his College education, none were more gratifying to him than those he received from Mr. Woodford, the founder of the scholarship he had held.

CHAPTER XXI.

FARM WORK.

THE first few days which followed the arrival of Jack and Webster at the Holt Farm were naturally devoted to settling themselves in, and in getting things into regular working order. Jack had brought with him a curious ornament for the hall, which he had long intended as a present for his father, but which was now to be given as a joint present from the two young men.

"But what is it?" enquired Holmes, "and what use is it? for I suppose it is something more than an ornament."

"It is one of the Fire Extincteurs," said Webster, "and I hope you will accept it from us, and let mine stand beside it. You do not know, perhaps, that I was Captain of the College Fire Brigade, and this is rather a fancy of mine."

Some little explanation satisfied Holmes that the present was very kindly meant, and might be useful under certain very improbable circumstances, and he accepted it with many thanks.

"Now, then," said Holmes, "let us have a little talk about business. You are now no stranger to us, Mr. Webster, and I shall therefore speak very plainly with you. You have come to learn farming, but I do not pretend to teach it. I have never taken a pupil in my life, and I begin almost to doubt whether I can do fairly for you, especially after all your College work. I know something of farming, it is true, for I have been bred and born to it, and I have worked at it for many years. If any information I have gathered is of use to you, it shall be cheerfully given, but I cannot let you be deceived as to what I can do for you."

"It may satisfy your mind, Mr. Holmes," said Webster, "if I mention that I was talking with our Principal at Rodney College one day about learning farming, and I will tell you what he said to me about it. 'Do not let any one lead you to believe that farming is to be learnt from lectures. These are very well in their proper place, and they are valuable if rightly used, but they are worse than useless if you rely upon them as a complete means for learning farming. As you acquaint yourself with every operation on the farm, you will find that there is a right way, and a wrong way, of doing everything. Take care and learn how work ought to be done. Consider yourself as without any knowledge of the subject—gather knowledge and experience from all around you, whether masters or men—strive to winnow away the lighter matter from the golden grains of farm experience, and store this in your granary for future use.' This will show you, Mr. Holmes, what I want to do, and in this I know you can help me thoroughly well."

"Having cleared this difficulty from my mind," said Holmes, "let me now tell you what I have advised Jack to do, and I say the same to you. Commence your work with a determination to know how to do every kind of work as it comes round day by day. Keep to your work as regular as any of the men, and make your notes every day of the work you have done, or which you may know that others have done. There is much work Jack has done, which you have not even had the chance of seeing done. Never mind his going to other work than yours, and which may appear to be more pleasant, for the time will come when it will be your duty to do these. If this meets your views, we will consider it as so understood between us."

This was cheerfully agreed to, and on the following morning Webster and Jack both went off with Tom Baylis to make preparations for carrying the corn, which was now nearly ready for being stacked.

"I say, Tom," enquired Webster, "but what are you going to

make the corn stacks up at that end of the field for? Would it not be better to run all the corn down the hill, and stack it in the bottom? Surely it would save both time and labour."

"Master said the stacks should stand in the old place," replied Tom, "and he don't throw labour away anyhow. He's got some good reason for it, I'll be bound. May be 'tis because we get more air up here, and we always like the wind to feel its way a bit through our stacks. It takes off the sweat more kindly."

"But I thought you let the corn get properly dried in the field, before it is carried to the stack—how is this, Jack?" enquired Webster.

"Of course they get it as dry as the season will allow," said Jack, "but this sweating is different to ordinary moisture. I say Tom, now, in a hot season, when you carry the corn nice and dry, does that corn sweat in the stacks afterwards?"

"The driest corn will sweat," said Tom, "it's nothing to do with carrying dry. Anyhow, that's where the stacks will be."

"But does the sweating do any good?" enquired Jack.

"Come, come, master Jack," replied Tom, "that's rather too good for you to try and catch me, after all your learning up at College—I call that rather too good."

Jack satisfied him that he was not joking on the matter, but would really be glad to know what he thought about it.

"If that be the case," said Tom, confidentially, "none of our corn is properly fit for use when it is first carried to the stack. Take oats, for instance: s'pose master had some oats threshed out as soon as they were ready to go to stack, and gave 'm to me for my horses, what would be the effect, I should like to know? It's just same with new-made hay, 'twould never do; they must sweat to bring the nature out of 'em."

"I see," said Jack, "this sweating is really a means for completing the ripening of the corn; and now I come to think of it, the Principal said one day 'that the changes in wheat were very

imperfectly known, and that many thought the ripening of corn took place in the harvest field, whereas it frequently happened that it was not completed for some months after.' This sweating is probably a portion of the ripening he referred to."

"But," enquired Webster, "is not wheat sometimes threshed in the field before going into stack? I suppose the millers use it without keeping it long, and in that case it cannot ripen properly. I wonder how they manage that. Tom, do you know much about the millers, and can you tell me how it is done?"

"Well," said Tom, "they don't grind it by itself, of course, but they mix it up with some old wheat. It pays 'em for selling quickly, but it hasn't the goodness in it for hard-working folk. That sort of flour mostly goes in for the towns-people, and may be when they've got some beef they don't notice the difference. I believe the millers do their best; but farmers will sell, and then millers must sell too, and of course somebody must use it; but you don't find the miller pick the flour of the new corn for himself if he can help it, any more than he gives his horses new oats. It don't add to the comfort of the skin, anyhow, you may take my word for that, Master Jack."

Later in the day an opportunity arose for their talking the matter over with Holmes. He quite confirmed what Tom Baylis had told them, but he added:—

"It strikes me that this ripening of farm produce is a much wider question than we are apt to consider it. If you come to think of it, the same thing applies to many other crops. Take Turnips, or Swedes, or Mangels,—if you begin any of these too early, you see the stock "tucked up," and evidently uncomfortable, in fact, like a school-boy who has eaten a lot of sour apples. If we get hot weather to ripen the common turnip, well and good; but if not, then we have to hope the frost will do it. The swedes rarely get ripened without frost, but the mangels we try to protect from frost, and ripen them in the "clamps" or "heaps." Practically we find that roots are safer and better food for stock after

they are ripened, whether they are ripened by the one or the other of these means. The use of unripe food, I believe, causes a double loss; for the animal is punished by the food not being in a suitable condition, and the food is unable to yield up its full amount of nutriment."

"You see, Webster," said Jack, "the frost and heat both appear to change the organic acids present in the food, but what is done somewhat suddenly by the frost is more slowly accomplished by warmth. I do not suppose that in other respects the action is entirely similar, for it appears probable that the steady change taking place when the roots are stored in heap would be attended with less violent action on the tissues, and would lengthen the time during which they could be kept."

"If such be the case," added Webster, "it would appear desirable to avoid the double action; for if your roots are first acted upon by the frost, you would probably find the warmth of the heap encouraging decay, rather than simply completing the ripening of the roots."

"That is just what we do find in practice," remarked Holmes. "If roots are to be preserved for any length of time in heap, we do all we can to secure them before they have been touched by the frost, for frost certainly hastens decay. If, however, we secure the roots before the frost has touched them, we have every reason to believe the ripening of the roots goes on all right."

"But," enquired Webster, "do you find much difference in the action of frost upon different roots?"

"Oh yes," replied Holmes, "some turnips and some swedes will stand much more frost than others. We found, last winter, amongst our experimental growths of swedes, that some of the slow-grown solid roots were to all appearance uninjured by the frost, whilst more quickly-grown and puffy roots perished very soon. How would you account for this?"

"Probably," said Jack, "from some of the roots having more

strongly-built tissues than others, and from the cells being filled with tolerably solid food, instead of poor sappy matter."

"In any case," added Holmes, "there we have the fact that, with just the same cost per acre, good management goes far to make the one crop of greater value than the other; and I, for one, shall never regret giving some time and attention to our experimental root trials. The further one proceeds, the more one sees the opportunities which farming offers for either good or bad results, according to the general character of the management which is adopted."

CHAPTER XXII.

THE ABBOTTS FARM.

THE fine harvest season found Jack and Webster working hard, now in the corn fields, and now at the stacks. Other work was rapidly following on, for as fast as the teams could get to work on the corn stubbles, there they were cutting up the surface weeds, and busily following out the autumn tillage work.

"I like to take Time by the forelock," said Holmes, "and I attack the weeds on the fresh stubbles when they are weakest, and gather them up for burning as soon as possible after the corn is cleared off. When this has been done, I consider I have stolen a march upon my enemy. You see, Jack, I can never catch the weeds in more feeble condition than immediately after the corn is cut, and I can therefore separate them from the soil much more easily than at any other time. In fact, I am glad to get clear of them, and I always push forward this work as much as I possibly can."

"Does it really save you so much time and labour," inquired Webster, "as to justify your attending to this additional work in the midst of a busy harvest?"

"That is my view of the case," said Holmes; "but my neighbour Foster, for instance, does not agree with me. If you watch his corn stubbles, you will be able to form your own opinion. Besides the decrease in the cost of cleaning the land, you will see I shall manage to work one or two of my earliest fields so as to get some spring food for the ewes and lambs."

Holmes was as good as his word, and he had a nice breadth of rye grass, vetches, and trifolium sown in good season. His neigh-

bour's stubbles were green and flourishing, whilst the stubbles on the Holt Farm were looking quite bare. Holmes's sheep, however, were, after all, far better off, for they were on the old clovers which were going to be ploughed for wheat. The sheep were soon to be driven from the clovers, as the time for breaking them up drew near, but a nice piece of turnips—moderate in size, but well matured—was ready waiting for them. It quite grieved some of Holmes's neighbours to see him plough down such strong pieces of clover ley, but he looked upon the clovers in a very different manner. He considered it a proof of good management to keep the clovers so strong and good up to the last, and when the ley was ploughed for wheat there was a gratifying promise for the following harvest. Jack and many others knew one of the secrets of his success, so he explained to Webster some of the circumstances which so largely contributed to that success, and directed him to notice the difference between his clovers and those of his neighbours.

"My rule," said Holmes to Webster, "is to do all I can to get a strong growth of clover. Sowing it with the corn naturally makes it grow tall and thin, in its efforts to get air, and if, when it has had this unfavourable early growth, we let the sheep come upon it in the autumn, the plant has little chance of settling itself firmly into the ground. Shepherd used to be as fond as I was for the sheep to pick up a little very tempting food off the young clovers; but we are now most careful to avoid doing this, or anything else that shall check the autumn growth of the young seeds."

"You seem to me, Mr. Holmes," said Webster, "simply to make the change of getting the sheep food from the old clovers instead of from the young clovers, especially as the old clovers keep so good up to the last."

"I gain in every way," said Holmes, "for by giving the young seeds the chance of establishing themselves in the land before winter, they start much earlier in the spring, and they make a

much stronger growth. It pays well to let them 'get the steam up,' and then they will go pretty nearly as fast as you like; but if you keep on checking them back at first they have got a very bad chance, even supposing the sheep do not destroy many of the plants."

"I suppose to-morrow you will commence ploughing the clover leys," said Jack to his father. "I expect they will plough up well, now."

"Yes, I think we may as well do so," replied Holmes. "Jack, you had better take one of the ploughs yourself."

"And shall I do the same, Mr. Holmes?" inquired Webster. "I am getting to like a bit of hard work."

"You shall begin your ploughing," said Holmes, "when we are breaking up the stubbles. We don't mind straight work quite as much there, and if your plough gives you trouble there it will make much less difference. You and Jack may as well walk over and see old Mr. Foster's clovers before they begin ploughing them. You will find that the Abbotts is rather a nice farm, and much of it adjoins ours."

No sooner said than done, and off went the two young men. Mr. Foster happened to be at home and received them kindly.

"Well, young man," said he to Jack, "so you've come back again after learning this scientific farming affair, but it will puzzle you to beat either your father or me with all these new-fangled ways. And is this one of your friends from the College? Well, you are welcome, but always mind I am for practice and none of your fine spun theories which make a man lose his money faster than he can get it. Why, bless my heart, Jack, how you are grown, it seems but the other day since your father came to the Holt and yet it must be more than twenty years since."

"I was born at the Holt Farm," said Jack, "and I was just twenty in February last, so you are about right, Mr. Foster. Did you live here when my father came to the Holt?"

"Yes, that I did," replied Mr. Foster, "and for more than

twenty years before that. Ah! Jack, those were the times for farming; you could do some good for yourself then, but that time's gone. I wouldn't have let my boy go in for farming if he had lived, but as you know here I am a lone man, with only my housekeeper to provide for, and yet I can't save money. I am sure I don't know how they manage where they have large families to bring up and educate. However, it's something for me to occupy myself about, and I'm accustomed to it. Would you like a walk? Then take some refreshment and we'll go."

"How have you got on with your harvest, Mr. Foster?" inquired Jack, "and how does it promise to turn out?"

"Badly, I fear," he replied; "the price is so bad you see it don't pay nohow."

"But is not that a good reason," inquired Jack, "for growing more to the acre, and so make up for bad markets?"

"Yes," said Mr. Foster, "that's all very fine, but there the seasons beat you. I say to myself sometimes, that what with heavy rent and taxes, low prices and small crops, it looks as if everything worked against the farmer. If you get a tidy bit of clover now, it's a wonder, it either gets the blight and dies off, or else it's too tender to stand the winter, or else they send you bad seed. Just look at this piece of ley they are ploughing for wheat."

"Then you have begun, have you?" said Jack.

"Oh, yes," said Mr. Foster, "we've begun, for the ground seemed likely to have no clover left if we had stopped much longer, and now it's ploughed I fear there's more weed than clover turned in."

"Do you consider this a good piece of land, Mr. Foster?" asked Webster.

"Yes, the land is well enough," said Mr. Foster, "if the seasons were any way thereafter."

"How are the sheep doing, Mr. Foster, and how are you off for keep?" asked Jack.

"The sheep are doing fairly well now," he replied, "we've got some good picking on the stubbles, and the young seeds are giving us some very nice feeding."

"But," said Jack, "is it not a bad plan to feed off the young seeds, don't you think it stops their chance of growing well next year?"

"Ah, my lad," replied Mr. Foster, "I suppose you'll allow me to know what is best for my land, anyhow. I see you have yet to learn how to make the best use of a good crop. I wonder how much of the leaf would have fallen before winter if it hadn't been eaten. I say, 'Waste not, want not.'"

Jack knew full well it would be unwise to challenge the views expressed, and the young men soon made their way again to the Holt, where they found Mr. Nicholson, who greeted them by saying—

"I only got back to Wrexborough yesterday, and I am going off to Rodney College almost immediately. The fact is, I have been making the best of my time on the Continent since I accepted my Professorship in that institution, for I wanted to see what the Colleges there are doing. The experimental farm stations pleased me very much, and made me feel somewhat ashamed of our own imperfect attempts. I have arranged to have a private laboratory at Rodney College, and a pupil-assistant for my own investigations, and I hear Professor Maynard, who holds the chair of chemistry, is also going in for research, so I hope we shall do some good work."

"I think," said Jack, "your researches would be more successful if the staff of Professors acted in full concert. I have noticed as a student, that different Professors give very different replies and explanations of a subject—not that any are wrong, but they differ—and I think you would gain many advantages by such concerted action, for any such variations of opinion may be so many threads leading to the discovery of new truths."

"Your suggestion appears reasonable," said Mr. Nicholson,

"and I will remember it. I must not, however, forget to tell you that you aided me in getting my appointment, for the Principal said you gave evidence of 'good teaching' on my part, which he considered as a matter of prime importance in a Professor."

It was with no idle formality that they bid Mr. Nicholson farewell. He had brought much light and joy into that household, and none could tell how far his work there might still bear further fruit; in fact, he was beloved, and they grieved over his departure from that neighbourhood accordingly.

CHAPTER XXIII.

WILLING HELPERS.

"You are ploughing down a good clover ley, Jack," said Holmes, as he came into the field the following morning with Webster. "I like the look of it, and I think the wheat will like it too. You may take it as a tolerably sure rule that you get good wheat where you have had a strong clover ley."

"Anyhow," said Webster, "it is very different from what we saw at the Abbotts yesterday. It seemed to me that the old gentleman blamed everything and everybody except himself. It never appeared to cross his mind that his own proceedings had anything to do with the result, or that he could possibly be in the wrong."

"If truth must be told," said Holmes, "I can sympathise with him; for, although I am a much younger man than he, I was steadily getting on towards having a very good opinion of my own judgment in farming matters; and, by the time I had got to his age, I dare say I should have got just as firmly convinced as he is, that to differ from his experience is the clearest possible proof of ignorance. I have had some extra windows put into my upper story, since Jack first went to Mr. Nicholson's lectures. I may candidly tell you that every now and again, I find fresh lights put in. I object and oppose at first, but 'tis no use, the truth will prevail; and after the truth is admitted, I regret the opposition I have made. The walls of prejudice naturally get thicker and stronger day by day; but some people are more skilful than others in letting the light in, and in this respect we shall miss our friend, Mr. Nicholson. Where he gained such an advantage was in

knowing as much about farming as those he spoke to, and so he kept himself fairly free from mistakes. However, we must go, Mr. Webster, or we shall be late for Wrexborough market."

Whilst Holmes and Webster were in Wrexborough, they met Mr. Hastings, the Chairman of the Science School Committee, coming from one of their meetings.

"I am quite glad to see you," said Mr. Hastings, "for our committee are in a difficulty about a science teacher, as Mr. Nicholson is leaving, and we find it a matter of considerable difficulty to find a thoroughly good teacher. We have decided to ask your son to take the lectures, and we shall greatly value his help."

"Do you think he can do it?" enquired Holmes, "but, if he can, I am sure he will be willing to help you."

"He can do it right enough," said Webster, "there need be no fear on that account."

"Is he in town with you, Mr. Holmes?" enquired Mr. Hastings.

"We left him ploughing for wheat, up in the Barn Close; and there he is now, I'll be bound," said Holmes.

Mr. Hastings took his horse, and soon reached the field, and informed Jack as to his mission.

"It would be folly for me to say I do not know the subject, and make that an excuse," said Jack. "You also know that I should like to do a service to a school in which I have gained many advantages; but still I scarcely like to undertake the duty, for it would appear rather presuming on my part."

"As that is all you have to say against our wish," said Mr. Hastings, "I shall certainly consider that you will do us the favour we ask."

"I cannot refuse my best services to the school," said Jack; "and, feeble though they be, they are at your command."

"I thank you very much for this promise," said Mr. Hastings; "but how is it about your qualification under the Government Department of Science?"

"There will be no difficulty about that," Jack replied, "for my

Certificate from Rodney College will be recognised as a full qualification. But why do you not ask my friend Webster to take Physical Science for you at the same time? He can do it thoroughly well—his College Certificate qualifies him; and when the pupils come for one lecture, by giving a reasonable interval, it would enable some to have a second lecture. Besides which, other pupils who have not had the chance of learning the subject may be glad of the opportunity. You will catch him on the road home, even if you do not get to Wrexborough before they start."

"I am very pleased with your suggestion," said Mr. Hastings; "and, with many thanks, I bid you good-bye."

Mr. Hastings met Webster on reaching Wrexborough, and having told him what had transpired, he ultimately consented to the proposal. The committee of the Science School were pleased to be free from their difficulty, and gladly acceded to the proposed extension of the work. When they got home, Holmes said to Jack and Webster:—

"I am really proud of you two young men in coming forward so nobly, and I am sure many will think the same as I do, and especially of Mr. Webster's kindness."

"I was regularly put in for the work by Jack's help," said Webster, "so they must thank him for it. However, we have been accustomed to work in double harness, and I won't desert him now. But, coming back to business, Mr. Holmes, I shall not like taking the fees; and yet, of course, they ought to be taken, otherwise it would make it unpleasant for others who may give lectures after, and wish to take the fees. I should like to turn the fees into a Scholarship, open to both persuasions, and I believe the girls will win it. It looks to me awfully cowardly that they don't give the girls a chance; and, in fact, if I did not think they would win it, I would restrict it to them; but we will pay them the compliment of making it an open competition, and I wish them good luck."

"I had exactly the same feeling about the fees," said Jack

"but I could not apply those of my class in the same way, for it would interfere with the Squire's Scholarship. Probably I could help in starting a lending library for the use of the science classes."

"Well, I declare I am getting prouder than ever of you both," said Holmes; "and I tell you what I will do as my contribution. You shall have my horse and trap to take you in for your lectures regularly."

"And I must do something," said Mrs. Holmes, "for I shall not let anyone show more interest in your work than I feel, so I will have a luncheon-basket and some refreshments for you to take with you. You will have the laboratory fire at your command, and you are both chemists enough to make yourselves a cup of good tea; so, with what I supply, you will be able to manage comfortably."

It was thereupon agreed that it should be a joint enterprise, in which all of them were to take a share.

On the following day, Jack wrote the following letter to the chairman of the committee :—

"Dear Sir,—In giving notice of the science lectures about to be delivered, please to add that an anonymous donor has arranged to place at the disposal of the Managing Committee a sum of money equal to the fees received from the class for the Principles of Agriculture, for commencing a lending library for the use of the pupils in the science classes of the Wrexborough school; and a further sum—equal to the fees received from the pupils in the class for Physical Science—as a scholarship for the best pupil in that class, whether male or female.

"Yours truly, JOHN HOLMES."

As they were gathered around the fire, in the evening, Jack said to his father :—

"I was thinking as I was ploughing to-day, what a grand preparation for wheat there is in the Barn Close. I should like to know what wheat you are going to sow there. I think you should be very careful about the seed-wheat you use."

"I am going to sow some of the wheat grown up in the Higher Close," said Holmes; "it is a good wheat, it gives a good average yield for the district, and the millers like it; in fact, it is our old stock wheat, and thoroughly naturalized to the district."

"I wish that at any rate a part of the field could be sown with wheat grown from selected seed," said Jack. "Dr. Thomson pointed out to us, one day, the variations to be found even in the same ear of wheat. Some grains are larger than others, some are better shaped, some are better skinned and show more quality than others. If you select any of these grains you get from their produce a large proportion like the grain of wheat you selected. If you make a similar selection from the wheat so produced, picking out the grains which have the desired character, you will obtain by their growth a still larger proportion of the sort you want. You may repeat this selection and growth year after year, until you get the produce almost entirely of the desired type. In short, he pointed out that you can breed your seed for quality as truly as any of your farm stock, and you can also cultivate seed from the larger and more productive ears of corn so as to get a more productive seed. I remember his giving us instances where crops of corn, grown under exactly the same circumstances, had been more than doubled in value by the use of properly cultivated seed. You have got a good preparation for wheat, and it now only wants some thoroughly good seed. Depend upon it, it is money well spent to secure the most suitable and the most productive seed you can. It will help you against the bad times our friend Foster complains of."

"We will try it, Jack," said Holmes, "for it seems to have a reasonable sort of sound about it; and a very small increase in

the yield of wheat would so far pay, that at any rate I should have no cause to complain."

"If you think of it but for a moment," said Jack, "you will see that there is no reason why pedigree influence should be so much neglected by farmers in the seed they use, when they know and admit its value in connection with live stock.

CHAPTER XXIV.

ONE GOOD TURN DESERVES ANOTHER.

As the time for Tom Hughes to leave for Rodney College was drawing near, he rode over to the Holt to see Jack before his return, and he found him ploughing in the Barn Close.

"We don't get such clover as this, Holmes, on our forest land," he said. "Our clovers are always very weakly."

"It is very likely you could get better than you do," said Jack. "I recollect Dr. Thomson speaking of your sort of land in connection with clover, and I am simply guided by what he said. Now, when do you put on your farmyard manure?"

"Our land is very sandy, you know," said Tom Hughes, "and we use some for the roots, but we find we must keep some for the wheat if we are to get anything of a crop."

"That is just what I expected," replied Jack, "and I will tell you why your clovers are so weak. Your land will not hold the manure, and nearly all the fertilising matter left by the root crop is taken out, or else washed out, by the time the barley is removed; so you have precious little left for the clover. Then again, I'll be bound you let your sheep have the run over the young seeds before winter, so as not to lose any food; in fact, you let the sheep eat it rather than the clover leaf shall be wasted, on the principle of 'Waste not, want not.' Our neighbour Foster adopts this rule, and he gets poor clover on good land; we do just the reverse, and we get good clover on land which is far from being as good as his. Depend upon it, Hughes, your father ought to alter his plan—although he will think me bold to say so; but if he were to use slowly soluble artificial manures for his roots

either bones or fully reduced superphosphates, with just a dash of ordinary superphosphate; and, instead of putting his farmyard manure upon the wheat put it upon his young clovers, things would soon look better on his farm. The way Dr. Thomson put it to us was this. If you have well and carefully rotted dung ready for putting upon the young clovers as soon as possible after the corn has been removed, they feed rapidly upon it, and the manure is soon changed into living vegetable matter, in the shape of an increase in the clover plant. Now, you will see you have gained two points by this—you save the soluble portions of the manure from being washed away and lost, and in the next place you have secured a strong plant of clover instead of the usual weakly growth. If you want to reap the full benefit, keep the sheep off the ground, let the clover luxuriate and make its growth as freely as it may; it will be a good preparation for a strong growth in the following summer. If you let the sheep eat it they will eat into the heart of the plant, and much will die before spring. Now, the principle which is involved in this is most important. By the use of a plant capable of quick and immediate growth you prevent waste of the soluble portion of the manure, even upon soils which have very little natural power for retaining manure. The roots of the clover not only supply the wheat with an equal quantity of fertilising matter, but it is in a better form because it is supplied gradually, as the plant requires it, and therefore not liable to loss. But it has many other advantages which I cannot now mention."

"I am really very much obliged to you," said Tom Hughes, "and I will certainly tell the guv'nor. By-the-by, Holmes, I got into a jolly row at home a day or two ago. I had got the guv'nor to order one of the 'Extincteurs' we had at the College, and as they were chaffing me about it, I asked them to let me try it on the kitchen fire as long as it would take them to count ten. Well, they agreed to it, but they never counted more than five, for the fire was out, and they regularly drove me from the place. They

are not likely to chaff me again about it, and they certainly will not let me have another go at the kitchen fire."

"You should not get up to these larks," said Jack; "you do more harm than good by it."

"Well," said Tom Hughes, "people don't all teach alike, anyhow, they all now know how to use the apparatus if it should be wanted. I am off to Rodney College in a couple of days, and I take young Edward Marston with me, who got the Squire's Scholarship you held. He is a smart little fellow, and will do well. Good-bye."

"Just give an eye to Edward Marston," said Jack; "try and keep up the credit of the Scholarship, without teaching the young fellow by any of your 'larky methods.' I suppose I shall see you at Christmas. Good-bye."

Little did Jack then think he would see him again very much sooner than that. It was scarcely three o'clock on the following morning when Holmes rushed into Jack's room to tell him there was a fire at the Castle. The bell at the Castle was ringing out the alarm, and a glance at the distant building told the tale only too plainly. Away went Jack to arouse Webster and the two lads that slept in the house, and in a few minutes one boy had been sent off to Tom Hughes to tell him of the fire, with a request to bring their "Extincteur," and the rest of the party with their equipments were making their way to the Castle as fast as a good nag could take them. On their arrival, Holmes remained in charge, whilst Webster and Jack made a hurried inspection. The kitchen, servants' hall, and the western wing were burning furiously; the butler and the servants in charge of the house—the Squire and his family being on a visit in Scotland—were well nigh bewildered. The great danger which was feared was that the fire would spread towards the central portion of the building. Webster, accompanied by Jack, the butler, and two or three others, hastened to unload the trap, and taking the command as by force of custom, Webster said—

"Jack, go with your 'Extincteur' to the back staircase, and prevent the fire crossing at that point. Bill, you follow Master Jack with the box of cartridges; always keep near him. Butler, will you fix a man for each of my buckets, to keep us supplied with water?"

Webster then put on his "Extincteur," and soon joined Jack. The fire was rapidly reaching across the back staircase, and for a time it was with difficulty kept under control. The two "Extincteurs," after two or three charges had been delivered, nearly extinguished the fire upon the staircase, but it continued to sweep through the western wing with unabated fury. By this time Holmes, having got his horse and trap disposed of, joined the party, saying—

"Well done, my boys, you are doing good work. What can I do for you, Mr. Webster?"

"Get our water carriers more steady," said Webster, "and keep us well supplied with water. I think we shall then be able to keep back the fire until the engine arrives."

Just at this time the wind brought the flames back into the staircase again with increased violence, and the passage-way was completely stopped.

"Jack, go up the front staircase, have some buckets and water-carriers with you, and do your best at the top," said Webster; "and Mr. Holmes, will you follow Jack and take some cartridges for his use? Butler, you had better have the books at this end of the library cleared away, for I am fearful of any timbers in this wall. And leave word for them to send Tom Hughes to me as soon as he comes."

The battle was steadily maintained, and after a time Tom Hughes arrived with his "Extincteur."

"You stand here, Hughes," said Webster, "and do your best to hold the fire back from this wall, for I fear the timbers run into the library, but if the fire gets through, go into the library at once. Did you bring any cartridges with you?"

"Yes, I have a good case of them," replied Hughes, "and this boy is my powder monkey."

"You come with me, Bill," said Webster, "and, Butler, tell them in the library to let Tom Hughes know if the fire comes inside the library, and then come with me to the kitchens. We will try and get at the bottom of this affair, any way we will know more about it."

In a few minutes Tom Hughes was called into the library, for the fire had got through the wall, and the wainscot was burning. The books had been removed, and the end of the room was clear, so that as the fire showed itself it was quickly extinguished. The water and fresh charges were well supplied, and Tom Hughes kept himself master of the position. At this moment a complete panic was caused by one of the servant girls going into hysterics, so Tom, anxious to prevent the attention of his helpers being distracted, turned the tube of the "Extincteur" from the fire for an instant, and by a well-directed shot the water touched the girl's ear, with one additional scream the girl recovered, and all were forthwith at "attention" again.

Meanwhile, Jack was maintaining a steady and successful contest with the fire in the "Boudoir" over the library. Webster had got into the kitchens. Loaded as the atmosphere was with smoke, putting on his respirator he was able to enter, and attack the fire at its fountain-head, with almost immediate relief to those inside the main building. Retiring from time to time to the fresh air, and obtaining fresh charges for his "Extincteur," the efforts began to show marked progress upon the fire. By the time Mr. Thompson and the fire engine had arrived they had clearly got the upper hand, and Webster went into the house again to join his helpers there. The three "Extincteurs" kept steady at their work, driving the fire from the main building, whilst the fire engine extinguished it in the wing. The moment for rest at length arrived, and well did the three young fellows enjoy a cessation from the contest. On examination it was found that the western wing of the Castle

was completely burnt out, but very little damage had happened in the principal rooms of the residence.

Early in the morning Mr. Thompson telegraphed to Mr. Woodford particulars of the fire, and informed him of the important services by which it had been kept within those limits.

CHAPTER XXV.

HIDDEN TREASURE.

By an early post a letter was received by Jack from Mr. Woodford, expressing his thanks for the zealous and most valuable assistance which had been rendered. He also added that he had heard with pleasure of the lectures which he and Mr. Webster had arranged to deliver, and he hoped to be present at the commencement of the winter session, when he would have an opportunity of thanking them both in person for all they had done.

That time soon arrived, and Mr. Woodford came down from Scotland for the purpose of inspecting the Castle and attending the first lecture. Personal inspection gave far stronger evidence of the severity of the conflict than he had learnt from his letters. It showed the great risk which had been run of an entire destruction of the property. In presiding at the first science lecture of the session, Mr. Woodford said :—

"I feel almost overpowered by the pleasure of being with you this evening. About four years ago, the son of one of my tenants was in the habit of walking in from his home to attend these science lectures. I saw him afterwards upon his father's farm, and was so pleased with the information he had gained that I felt it my duty to encourage the good work, and I provided a Government Scholarship which this young man afterwards gained. He passed his course of study in Rodney College most satisfactorily, and on his return home he very largely helped to save from destruction the Castle, and what are to my mind its many almost priceless heirlooms. It is now my pleasure to introduce him to you as willing to aid you. Do you think I shall ever regret the small outlay by which

I secured that Scholarship for him? I say, he has discharged any obligation he was under to me for it, and he has made me his debtor. I also thank those associated helpers who so kindly aided in the protection of my property, and, having said thus much, I will leave you in the hands of my worthy young friend, Mr. John Holmes."

In the lecture which Jack then proceeded to deliver he announced his intention of following as closely as possible in Mr. Nicholson's footsteps. Webster had no such a precedent to follow, but his lectures were equally simple and accurate. Both classes were numerously attended, and the anonymous donor soon provided the promised sum of money for the purposes already named. The donor was known only as "Nil Desperandum" and the secret was well kept. Some thought it was Mr. Woodford, but this he distinctly disclaimed.

As soon as the wheat sowing was ended the two young ploughmen were turned in with those breaking up the cleaned stubbles, laying the ground up rough and rugged for the full action of the winter frost. For a time Webster had help, but he dispensed with it as soon as he could, and both stuck well to their work. One evening as they were talking with Holmes about their work, Jack said :—

"This disintegration is a grand help to the farmer, and as far as I have ever heard few seem to know its full value."

"What do you mean, Jack?" enquired Holmes.

"I mean," said Jack, "that all this ground we have laid up rough will be enriched by the frost, rain, and air, and will be so broken up—or disintegrated—that it will be more fertile in the spring than it is now,—practically it adds manure to the soil."

"I would like to know how it gets manure added to it," said Holmes. "I know, of course, that the land gets in better working condition, and that the labour in spring is reduced in consequence."

"As I understand the matter," said Jack, "it stands in this way. It is only a small portion of the soil which is useful for plant-food, the great bulk of it is a store for future generations. None of the soil is useful as food for a crop unless it can be dissolved in water, and so carried into the very fine water-pipes which exist in all plants. We were, therefore, taught to consider the soil as consisting of two parts—the one portion which could be used as plant-food is called 'active,' and the other portion is called 'dormant,' or sleeping. It appears that the frost, air, and water acting upon the soil bring some of this dormant matter into a useful condition, and, so far as it does this, it practically adds so much plant-food to the soil. It is a matter of small moment whether you go to market and purchase this food and add it to the land, or make one part of the soil supply it to the other part."

"Except in a matter of cost," interposed his father.

"That is perfectly true," said Jack: "I only meant to say that so far as the supply of plant-food is concerned, it is in both cases so much food added to the active portion of the soil. Some prefer purchasing these supplies, others prefer making the soil give them up. A friend of mine recently described this by comparing it to a farmer who had plenty of corn in his granary, but rather than unlock the granary door, he would send to the corn merchant and purchase his supply. He meant this to show that a farmer should unlock from the soil the enormous supplies of plant-food it contains and make good use of it."

"Did either of you see in the newspapers," inquired Holmes, "what Dr. Voelcker stated at Birmingham as to what Mr. Prout had done on his property? Practically, he kept up a continuous growth of corn for many years, and sold all the produce off the farm to an extent averaging about £4,700 a year. The fertility of the land was more than maintained by artificial manures purchased to the extent of about £1,000 a year, and yet the property (450 acres), which, with improvements, cost in or about

1861 £22,000, is now worth £33,000. I think, Jack, Mr. Prout must have learnt how to unlock these stores of fertility in the soil, and with very great advantage to himself, whilst at the same time providing for the improvement of the soil."

"Yes, I read the account," said Jack, "but no one in the country takes more care than Mr. Prout to get the land thoroughly well steam-ploughed in the autumn; thus he improves his land by making a larger proportion of it active, and thereby it becomes more useful. We had this system discussed at one of our College Conversaziones, and I recollect Dr. Thomson saying that many most valuable lessons were taught by Mr. Prout's practice even when this system could not be fully carried out."

"I very well recollect his saying," added Webster, "that he thought much of the future profit of the farmer would depend upon his making a judicious use of this granary key for bringing some of this vast store of wealth into active use—in fact, getting profit out of what was now unheeded and unsought. Then, if you recollect, Jack, he also said that by the aid of science we ought to be able to assist the soil to draw from the atmosphere some of the ammonia we want, instead of buying it all at £100 a ton."

"Turning to another subject," said Holmes, "I should like to have a look at your farm diaries, and see how you are keeping your notes."

The two books were produced, and carefully looked over by Holmes. After doing so, he said—

"In my opinion you want to keep fuller notes than these, and although you come in tired after your work, still it is worth the effort. I am thinking it would be even worth your giving up one day in the week from your farm work for the purpose. Suppose you keep your rough notes from day to day, and make up more fully every Wednesday or Thursday. When you have made your notes, they ought to enable you to place the men at any similar work a second time; or, if you can improve upon

my arrangement, so much the better. Your diary, to be of any real value, should enable you to do this, and I should like you to keep this object in view."

"Thank you, Mr. Holmes," said Webster, "for your kind suggestion. I can see it will make our notes much more useful for reference afterwards. I heard from home this morning, and they are very pleased to learn what we are doing about the Wrexborough lectures. They are surprised that there are so many ladies attending our classes; but the best of the joke is, that my sisters are thinking of attending some of the science classes in Edinburgh, for they say they are not disposed to be left behind in the general movement which is taking place. Dr. Whichcord met me in town the other day, and mentioned one science school which had been opened in London in which over 600 young ladies entered as students in the first year of its establishment. I am really glad I have joined in this work, and I should like to see one of the young ladies in my class get the scholarship, and enter one of the Ladies' Science Colleges. I should like to see girls thoroughly well trained—not mere surface work, you know—they will then be less anxious to display their knowledge, but when they join in conversation, or have duties devolving upon them, they will be able to hold their position as well-educated girls should do. After all, Mr. Holmes, it will give them the chance of becoming more valuable members of society, and to my mind this need not detract in the slightest degree from their other charms."

CHAPTER XXVI.

A NEW PATRONESS.

THE confusion in the Castle consequent upon the fire induced Mr. Woodford to prolong his stay in Scotland longer than he had intended, but the efforts made under Mr. Thompson's direction enabled the family to return for a very short visit at Christmas. On an early day after the Squire's return he sent a note to Jack informing him that Mrs. Woodford would like to see him, and also Mr. Webster, and naming a time for their call. The two young men obeyed the summons in due course, and Mrs. Woodford said to them—

"I have had a great wish to thank you in person for your devoted conduct on the occasion of the late fire, and for the skill you then displayed, and I hope you will accept from me some acknowledgment of your kindness. It has been rather difficult for me to decide its form, for I particularly wished to associate a lasting utility in the gift with the probable necessity for its frequent use. I have, however, decided to present to you, Mr. John Holmes, a collection of standard works upon agriculture, and for you, Mr. Webster, I have selected a microscope, which I hope will meet the critical judgment of one who I hear is well able to judge of its merits. Whenever you make use of these gifts I hope you will remember the grateful thanks of the donor."

The presents were accepted with due respect, and the young men were invited to luncheon. Mr. Woodford was glad to have a long and quiet chat with Jack, whilst Mrs. Woodford more particularly engaged Webster in conversation. The luncheon was

nearly finished when Mrs. Woodford arrested her husband's attention by saying:—

"You will be surprised to hear that Mr. Webster is a son of the late Col. Horace Webster, so many years my brother Robert's commanding officer."

"It is possible?" said Mr. Woodford. "Well, this is most singular. You must have seen my wife's brother, Capt. Robert Wyndham, for he was very intimate with your father."

"I cannot say that I remember seeing him," said Webster, "but I seem to know him, for we have a painting at home in which my father and he both appear, and the faces are spoken of as excellent likenesses. We children know it as the V. C. picture."

"I have never seen that picture," said Mrs. Woodford, "but I have often heard of it, for it depicts the brilliant affair for which your father obtained the Victoria Cross in saving my brother's life—and how remarkable that you should come down here to learn farming. Did you know of our connection with the Victoria Cross affair?"

"No," replied Webster; "it causes me as much surprise as it does to yourself. My father has been dead for fully ten years, and since his death our family have lived very quietly in Edinburgh. We have therefore lost sight of many of our friends in the army, and many old associations."

Mrs. Woodford asked for and obtained Mrs. Webster's address, and other subjects then attracted their attention. Webster told Mrs. Woodford of his interest in female education, and the hope he entertained that the scholarship of his science class would be gained by one of the young ladies attending his lectures. He also told her of the College Conversaziones, and the excellent opportunities they gave for assisting the pupils, and added:—

"If you had not been going away so soon, I would have pleaded for the favour of your presence at a conversazione in Wrexborough, so as to have secured your countenance and support."

"I will gladly help you," said Mrs. Woodford. "We leave here on Thursday week, possibly you could arrange for it on the previous Wednesday. If so, I will hold myself free, and I am sure Mr. Woodford will come with me."

"I think we shall be able to arrange for that evening," said Webster, "and I am exceedingly obliged to you for your kind consent."

Jack and Webster took their farewell of Mr. and Mrs. Woodford, and the presents were sent to the Holt Farm the same afternoon; but the messenger had then to proceed to the Forest Farm, for Tom Hughes had not been forgotten. During the evening Webster took the opportunity of having a family council respecting the conversazione arrangements. Mrs. Holmes went into town on the following day—which happened to be the regular day for the lectures—to assist in making some of the arrangements. Mr. Hastings and Dr. Whichcord very cordially assisted—the Assembly Rooms were engaged, both of the science classes were invited to be present, and subsequently many other invitations were issued.

The Science Conversazione was a decided success. Mr. and Mrs. Woodford were present, and by their kind and judicious manner did much to encourage the objects for which the conversazione had been arranged. It was something perfectly new in Wrexborough, for the town was so peculiarly constituted that very few gatherings possessing any sociability of character had been possible there. If truth must be told, every one assumed to himself, or to herself—for the ladies were by no means free from the weakness—a certain position in the local scale, and they could only associate with those of that scale, or of course—if they had the chance—with something higher. The presence of others—if even one-tenth of a degree—lower than themselves could not be put up with for a moment; for it rendered such a gathering unfit for their association. When the variation was so great as between Mrs. Woodford and themselves, it was obviously useless

to think of the petty variations supposed to exist among themselves, more especially as the example she set of courteous consideration for others could not fail to commend her example to their better judgment. Consequently, the gradations on the local scale for a time ceased to be considered, and when the conversazione ended, they all agreed that the evening had been most entertaining and instructive.

The primary object of the conversazione was very fully attained. The ideas of relative respectability had hitherto kept back many from becoming pupils in the science classes, because "somebody else" attended the class, but the very interesting scientific entertainments of the evening led many to inquire,—"Shall I refuse to gather flowers from the realm of science because humbler hands can do the same? Is their beauty decreased because they have given joy to some whom I consider inferior to myself?"

Wrexborough learnt that evening a lesson which will never be forgotten there, and when the science classes met in the following week there was a considerable increase in the number of pupils. This was rather a source of difficulty to Webster, for he found he would have to check the progress of the more advanced pupils if he kept them all travelling in company, unless he provided supplemental help for those who knew very little about their work. He decided upon adopting the Rodney College system, of supplementing the lectures by tutor's classes for the more backward pupils, and these he arranged to have taught by the best male and female pupils in his general class. It gave some additional trouble to these tutors, no doubt, but he found by their vivâ voce examinations that this work advanced them in their knowledge of the subject, whilst it helped the slower travellers to keep within a reasonable distance.

There was work to be attended to at the Holt Farm, as well as at the Wrexborough Science Schools. Holmes now found it necessary to give the shepherd more help, and he placed both Jack and Webster with him as helpers. George rather liked their

company, for they worked very fairly, and he could often exchange his views with them.

"Shall you ever forget, Master Jack," inquired the shepherd one day, "what a sad trim our ewes were in, this time four years ago? You didn't know as much about sheep then as you do now. I shall never forget that time, but we've kept well out of that trouble since. Our swedes be so much better than they used to be, and giving the sheep some good hay, the ewes go along first-rate. You've told Mr. Webster all about that time, I dare say."

"Yes," said Webster, "I have heard about it, and also how you told Mr. Holmes about the clover roots."

"I don't feel ashamed now," said the shepherd, "to ask the master to give me a fair allowance of hay for the sheep, and I am as proud of the clover as ever he is. One neighbour, old Mr. Foster, happened to come across here some few days ago, and he liked the look of the swedes and the hay uncommon well. I asked him, joking-like you know, whether he could do with some of them at the Abbotts, and he said, 'Why, George, I should then have to keep all of my own growth for the calves,' and I said if I were he I should give the best to the calves, but giving me a poke on the ribs, he said, 'Why don't you see the calves wouldn't know the difference,' and away he went laughing at the joke, but I've never seen such food grown on his place, and I don't s'pose I ever shall, although it's a deal better land than this farm. But talking about the food for the sheep, I do wish you would some day talk to the master about letting me have some malt-combs for the sheep. They be wonderfully good for 'em, and I'd like to see some in the granary again we want 'em."

"What are malt-combs?" inquired Webster.

"The sprouts produced from barley by its germination during malting," said Jack.

"Would you not like some of the malt itself, shepherd?" said Webster, "surely that is better."

"Well," rejoined shepherd, "I'll be quite content if I get the malt-combs, any way, for the present, but some day, may be, we'll get the malt as well."

"But why do you say 'may be,'" inquired Webster, "why cannot a farmer make the best use of his own barley?"

"You don't understand about the Malt Tax," said shepherd. "Well, master can tell you more about that than I can, but you mind what I say—we'll have fair-play even yet about the Malt Tax."

CHAPTER XXVII.

THE MALT TAX.

WHEN Jack had a convenient opportunity he named to his father that the shepherd wished to have some malt-combs for the sheep.

"He shall have some, Jack," said Holmes, "for I like them to be used as much as any one can, but they cost all they are worth, and I think a little more. George, I believe, loves his flock as much as his children, and he asks a favour for the sheep almost as reluctantly as if they were his own. Depend upon it, when you do get a man thus interested in a flock, it is worth your meeting his fancies now and then, especially if they are right. You need not say as much to him, for some men lose their balance if they think they are valuable. However, he is a very good fellow."

"He was joking me," said Webster, "about the Malt Tax."

"You are not the only one who has been joked about the Malt Tax," said Holmes. "The joke fell harmlessly upon you, I do not doubt; but when men are smarting from its influence they don't like to be tormented with a joke; in fact, they don't look upon it as a joking matter. I fear that we farmers have been done—yes, completely done—over this job more than once. Some years ago there was a Committee of the House of Commons upon this very subject. They missed the mark altogether, and, if I remember rightly, they came to the conclusion that malt was not so much better than barley as to justify our being allowed to malt our barley for feeding our stock. Farmers who had used it right saw its value, and spoke in its favour; but those who had

used it wrong spoke against it. Practical men differed in their opinions, and were thus paired off so as to balance each other; but that does not alter the truth."

"Why could not farmers please themselves," inquired Webster, "and let those use it who liked to do so?"

"It is so linked in with the Excise regulations," said Holmes, "that they fear it would influence the revenue."

"But, surely," said Jack, "there must be some middle course which would meet the difficulty?"

"That has always been my idea," said Holmes. "We had the 'Gladstone Mixture,' but that did not meet the case at all, and it was never of any practical value."

"What was this 'Gladstone Mixture?'" inquired Jack.

"I am not quite sure," said Holmes; "but anyhow the barley had to be mixed with linseed, and no one cared to use it in that way."

"As far as I understand the action of malt," said Jack, "this mixture was not likely to answer. I'll be bound that Prof. Nicholson would help them so that malt could be put to its best use as food, and yet not be suitable for brewing purposes, for these, I suppose, are the main points to be secured."

"I really hope," said Holmes, "Rodney College men will do something for us. I believe, if we could only show the Government how the thing could be fairly carried out, they would see justice done to the farmer."

"George says he thinks the time will come when farmers will have fair play about the Malt Tax," added Webster.

"It is not exactly fair play to put the farmers of this country to a disadvantage," said Holmes, "but we must be reasonable, because, whilst we demand fairplay, we must be equal and just towards the other side. The Government cannot do impossibilities, any more than we can. In my opinion, the farmers should determine how the alteration of the law can be made, and submit such a plan to the Government, with proper evidence in its

support. I fear that otherwise we might just as well protest against the rising of the tide. . . . Well, now, Jack, about to-morrow. I must take you from the shepherd to-morrow, for we shall commence threshing the wheat from Stoney Croft. I shall leave you to arrange the men in the morning, so as to go on with that work properly, and you had better stick to that job so long as we keep the engine and thresher."

When Holmes came round in the morning, he made very little alteration in the arrangements, for Jack had remembered the hint given to him; and having recorded in his diary the position of the workers at the previous threshing, he was tolerably prepared for the emergency.

"What do you think, Mr. Holmes, of the quality of the wheat they are threshing?" asked Webster on the evening of that day.

"The quality is not very gay," said Holmes, "and yet the millers like our wheat; they consider it a good strong wheat, and they like it for mixing with some foreign wheats."

"Then, I suppose, they give you top market price for it," said Webster.

"No, they don't," said Holmes, "and that is the unfortunate part of it. They always say when they are going to buy they will have to get foreign wheat to make it work at all; but my belief is that it is too good in some way for being used as it is."

"I believe," said Jack, "that with such strong clover leys as you have had for the last three years you are bound to have strong wheats. Have you seen any of old Mr. Foster's wheat lately? I would like to know how that compares with yours."

"His wheat has not been worth so much money as mine for the last two seasons," said Holmes, "and, although he has got better land, his wheat is not now as strong as mine."

"Do you recollect, Jack, the discussion we had at Rodney College about wheat?" asked Webster, "and the reference made to some recent investigations—not then published—but which showed how greatly the quality of wheat varied."

"Yes," said Jack, "Dr. Thomson said he was informed by the investigator that the composition of wheat was known to vary so far as to contain from 3½ lbs. to nearly 7 lbs. of flesh-forming matter in a bushel—practically double as much in one case as in the other. The produce of flesh-forming matter from an acre of wheat varied as much as from 28 lbs. to 256 lbs.—or nine times as much in the one case as in the other. He said it was wonderful how skilful millers had become in judging the composition by the eye. He spoke very much in favour of well-selected seed increasing the yield per acre and the market price of the produce. I am in great hopes that we shall turn out some better wheat next year, and more of it. After all, the extra cost of the seed is small, considering the reduced quantity of seed used per acre."

"Well, Mr. Webster, how do you like being with shepherd?" inquired Holmes.

"George and I get on first-rate," said Webster. "We are now going to begin about fixing up the lambing fold, and it strikes me he is right in making what might at first appear to be an excessive preparation. From what Professor Armstrong has taught us, it appears to me that George is right in taking great care to protect the ewes and lambs from cold and wet. I think we shall have a grand fold, for he says he shall improve upon the one he had last year. He says he hopes to have Jack with us after a time, and Jack and I can take turn and turn, so that one of us will always be with him. If that be so, I shall propose that only one of us goes in for the Wrexborough lectures after we get busy with the lambs. Jack can take both lectures one week, and I will take both for the next, so that we need not neglect the sheep."

And thus it was arranged, and right well were the duties discharged. Never before had George received such skilful assistance, for in any real difficulty his helper—controlled by George's experience and caution—gave proof of the value of his hospital training. The flock had never done as well, and George had much more rest than had fallen to his share in any previous

lambing season. Towards the end, George found he could trust either as well as himself, and he acknowledged that in some cases their work was even more skilfully done than he could have performed it.

As soon as this busy season was over, the young men were excused from farm work so as to be able to go into Wrexborough twice weekly, and they had also to carry out the second and last conversazione for the season. Much to every one's surprise, Mr. and Mrs. Woodford ran down from London for the purpose, and another most delightful evening was spent. The Government examinations came on in due course, and William Ellis, of the Birchwood Farm, obtained Mr. Woodford's scholarship, whilst the "Nil Desperandum" scholarship in Physical Science was awarded to Miss Ellen Temple.

Mrs. Forbes did not fail to keep Jack in mind of his promise to help her in the cheese difficulty, so taking advantage of a convenient opportunity the young men drove over to see Mr. Forbes' farm and the dairy.

"Glad to see you both," said Mr. Forbes; "with two doctors we shall certainly do something, but I wish you had got Mr. Nicholson with you. I wonder how he gets on in Rodney College."

"I heard from him not long since," said Jack, "and he gave me a good report. He gets on capitally with the Principal and Professors, and I hear from Tom Hughes that the students like him very much indeed. But what are we to inspect here?"

It was decided to have a walk round the farm and the buildings, and after an early dinner to see the dairy.

"These are not very nice sheds for your cows," said Webster. "You ought to get your landlord to put up some better places than these."

"I wonder who is to pay interest in these bad times," said Mr. Forbes. "A few boards where the sides are faulty will make them do for me."

"But surely the sheds are not cold," said Jack, "I should like to give the sheds more fresh air if they were mine."

"If we don't keep the cows warm we should be nowhere," said Mr. Forbes, "they would be taking cold and losing their milk. Even now I have got as much as I can do to keep them right. There are three cows right up at the further end of the shed terribly bad, and none are as gay as I like to see them."

"Now does not that show you one cause of trouble?" inquired Jack. "It is because they are so far up in the shed that they are the worst, for the simple reason that they have the least chance of getting fresh air. If it were my shed I would soon lift off some of the boards and give them more air. I believe you would be a gainer by doing so, and have some openings in the opposite wall. If you give them fresh air you adopt the best means for preventing cattle taking cold. I would like to know where you would be most likely to catch cold yourself, by staying all day in a close wash-house full of steam and going out into the cold to drink occasionally, or by breathing fresh air all day."

"There is no steam in the cow shed," replied Mr. Forbes, "and the things are altogether different."

"They are only different in degree," said Jack, "and the cow sheds are much the worst, because you have not only got steam, but foul steam, steam loaded with decaying matter, and as the cows are compelled to breathe it, it is enough to make all the secretions of the body bad and unhealthy. I know Professor Armstrong took that view of it, and he said it would affect the milk, producing in it rank and offensive animal oil, which is enough to spoil any cheese. Then again I noticed your water supply is anything but good. Can you imagine your keeping yourself in health, if you had to drink foul and offensive water? Neither should you expect cows to be in a healthy condition if they take such bad water."

"But don't you think the cows know whether it suits them or not?" inquired Mr. Forbes.

"You do not give them any choice," replied Jack; "you know of course what mischief has happened to human beings from fever germs being conveyed by the milk. From what I learnt at Rodney College, I believe that if you give your cows plenty of fresh air—plenty of clean water and good food—you will save your wife from much trouble, and sell your cheese at a better price. It may not enable you to get over your trouble entirely, but it will certainly reduce it, and when we come again we will see the dairy, and possibly something else may demand your improving care."

CHAPTER XXVIII.

GOOD FEEDING.

JACK and Webster had been comparing the spring tillages on the Holt Farm, with those on the Abbotts, and with much interest. The corn stubble which had been so useful on the Abbotts Farm as giving some sheep-feed in the autumn had been ploughed during the winter, and some portions were ploughed late. Holmes did not appear to be in any hurry to disturb the ground ploughed before winter, for he studiously avoided any operation which should bury the "seed-bed" which Nature had provided by the winter rains and frosts. Where the weeds had grown on Holmes' fallows and had to be attacked, it was done by stirring and cultivating in fine weather rather than by cross-ploughing. Webster, in speaking to Holmes on this subject, mentioned the terrible work they had got on old Mr. Foster's farm.

"You are quite right in your conclusions," said Holmes, "as to what I want to do in preparing the land for roots. I want to keep the fine mould on the top, and, except where some weeds make it necessary, I do as little to it as possible. I know many a man who ploughs his land up thoroughly well before winter as we do, and then breaks down the land too early in the spring, burying the fine mould, and fails to get a fine seed-bed during the season, however much labour is put upon it. Our stubbles from being cleaned in the autumn will give but little trouble now. You will see that we shall get our roots in with one-quarter the trouble Mr. Foster has, for he not only left his weeds to grow and get strong, but then he buried them, and now he has to get the

rubbish worked out of the land. In doing this any fine soil produced by the frost will sink, and unless it happens to be a very favourable season he will be late in sowing his roots."

"Do you not think, Mr. Holmes," enquired Webster, "that the carting of the dung for roots is very likely to injure the land?"

"Yes I do," said Holmes. "We took advantage of the frost to get some farm-yard dung out on some of the land for roots. If we get some good weather, which will let us draw out some more dung without damage to the condition of the soil, I shall do so, but I will not be tempted to injure Nature's seed-bed. I would rather depend entirely upon artificial manures for the roots, and save all the farm-yard manure for the young clovers. By-the-by, Jack, Mr. Thompson has asked me to draw up a report about the root experiments of last season, so that the farmers of the neighbourhood may have it sent to them at once. We will do it this evening, and I will see him to-morrow about it."

"I wish," said Jack, "you would ask him to offer a prize of £10 for the best green food for the turnip fly. We find the mustard do fairly well in some places, and it certainly answers with us to keep the fly off the swedes, but very likely there are some better plants which could be made use of. There can be no need for making the young swede rush into life at a gallop, to escape this hungry enemy which is waiting to spring upon it. It must be a wiser policy to give the enemy some other food which it will prefer to the young swedes, and then let the youngsters begin the journey of life more slowly, and keep in better condition for a long and steady growth."

"Now you have got two students on your farm, Mr. Holmes, I suppose you will try and grow some of the Student Parsnip," said Webster. "Do you know its history?"

"I don't know the sort at all," replied Holmes. "What is it specially good for?"

"It is specially good for two things," said Webster. "It is of

good quality, rich flavour, and a good cropper; and, in the second place, it is a splendid example for encouraging the production of new varieties of our cultivated crops from the wild plants. Its history is short, but important. Professor Buckman collected some wild parsnips, and sowed the seed in an experimental garden, for the purpose of showing the students in the College at Cirencester how to improve these wild plants. In a few years he improved the growth wonderfully, and he obtained one variety better than the rest, so out of compliment to the good fellows around him he called it the 'Student' Parsnip. It is now acknowledged to be our best parsnip, and as 'like produces like' it can't be a bad sort anyhow. We have been trying the same sort of thing up at Rodney College with the Beetroot. The students are doing this work there, and they are improving year after year, but they don't mean to stop until they get some particularly good, worthy of being called the 'Professor' Beet."

"No, no," interposed Jack, "that won't do for Rodney College anyhow. We can't have a Professor beat there, it would be something quite new for that College."

"However," said Webster, "that is their matter at present, but when Jack and I become Fellows of Rodney College, and take part in the management, we shall do our best to have things called by their right names. But talking of the College reminds me that, as you will soon be losing two such valuable helpers as Jack and myself, it may be worthy of your consideration whether you might not get two pupils from the College to take our places. There are many young fellows leaving there, after having got their Science Certificate, who do not know where they can best get their knowledge of farm work. I am sure some would be glad of the chance of coming under your instruction. If you thought proper, I am sure Dr. Thomson would be pleased to place your name upon the 'Farm Tutors' board in the Hall as willing to receive two students."

"I must consider about that," said Holmes, "but at any rate I am very much obliged to you for suggesting it."

In consultation with Mrs. Holmes it was decided that it should be done, and it was accordingly carried into effect. The time was now come for sheep shearing, and the shepherd claimed his two helpers to take part in the work. On their return at the end of the first day's clipping, Jack told his father that the shepherd considered the wool heavier and better than he had ever had it before.

"I am not surprised at that," said Holmes, "for we have been steadily improving for the last three seasons."

"Good clovers and good swedes will tell their tale on the wool," said Jack. "We were all much interested in Dr. Thomson's lectures upon the structure and the growth of wool. There is no doubt, from what he said, that the food makes a very great difference in the character of the wool. Climate, certainly, is very influential, but still we can greatly control the length, the strength, and the softness of wool by the food given to the sheep."

"That I think is probable," said Holmes. "I know when we had such trouble with our sheep, and especially with the ewes, four or five years back, we found the weight of wool much less than it ought to have been, and we had also complaints of its want of strength. The buyers gave a lower price, because they said it would break in the working. I can understand our not getting so much wool, but I don't see how it became unequal in strength, or as they described it as wanting an evenness of staple. If it were fine and weak I am told it would not matter so much as when some portions are stronger than others."

"In all probability that arose from the tension which was necessary for the stronger portions being too great for those parts which were weak," said Jack. "As far as we know, that weak portion of the fibre of wool arises from some check in the supply of nourishment, and may arise from the sheep having poor food,

or from some unhealthy condition of the body diverting the supply. The great thing seems to be, to avoid anything like a sudden change in the quality of the food. You may change the food as much as you like, but you must avoid any great deficiency arising in the nutriment supplied. When the wool is examined under the microscope, we can detect these periods of insufficient food. I have no doubt that when you used to grow swedes which never satisfied the sheep because they had 'no heart' in them, and were consequently such 'gay deceivers' both to you and the sheep, there really was not sufficient nourishment in the blood for the support of the body—certainly none for its growth—therefore the supply to the wool would be checked, and a fault in the structure was the natural result."

"The greater weight of wool we now get results no doubt from a greater supply of food," said Holmes, "and is the direct consequence of giving better food. I should say that there can be no doubt, but that both our clovers and our swedes have much more feeding power now than they used to have. I don't know what may be the full chemical explanation of the question, but I have no doubt of the fact."

"In that case, Mr. Holmes, your neighbour at the Abbotts ought not to have such good wool as you now have," said Webster. "It would be curious to know whether the better quality roots and clover you have grown during the last four years have influenced the weight, and the selling prices, of your wool and his."

"I never took that view of it before," said Holmes, "but as far as I remember I have certainly made a better price than he has ever since that time; and I may safely say I have had a heavier cut of wool."

"All this shows," said Jack, "that there is nothing like working for a high quality produce, for it is a sound foundation to rest upon. The swedes and clover we now grow have not cost any more than they did under the old plan, and yet the sheep are

better in health—there are fewer losses from deaths—they are worth more money—and the produce of wheat and barley has been increased. After this next harvest, I expect to see still greater improvement in the quality and yield of the corn, because I am sure that in future you will go in for thoroughly good seed."

CHAPTER XXIX.

SCOTCH FARMING.

MR. HOLMES'S name being registered in Rodney College, quickly secured for him two pupils, and arrangements were made so that they should take a month's holiday after the end of the College term, and then proceed to the Holt Farm.

"Well, Jack," said Webster, "as the new tenants are decided upon we must arrange to clear out; I will therefore learn the Mater's wishes about our new berths at once."

Negotiations were shortly commenced, for Mrs. Webster left the arrangements in Holmes's hands. They did not terminate exactly as any of them wished, for there were difficulties in finding one of the right sort of men who had two vacancies. They had no choice but to be located within three miles of each other, and upon farms of a somewhat different character. The gentleman with whom Jack was to be placed had a good stock farm; he was a successful grazier, and some little dairying was also carried on. Webster, on the other hand, was to go with a heavy land farmer, noted for his herd of pedigree shorthorns. Both men had the reputation of being thoroughly good agriculturists, and well adapted for aiding their respective pupils in different systems of farming from that which was carried on at the Holt Farm.

"We must go over and see Mr. and Mrs. Forbes before we go," said Jack to Webster, "and see how the dairy work progresses. I am fearful they will think I have done nothing to help them in their trouble, but, as you know, I have had very little spare time."

The visit was arranged, and paid in due course, and they learnt from Mrs. Forbes that the milk had certainly improved in character, and she hoped with advantage to the cheese.

"But," enquired Webster, "is it not probable that the condition of the 'vells' used for making the rennet has had more to do with the trouble you have had than you are apt to think?"

"I think that is tolerably certain," said Jack, "for it must be remembered that you are dealing with very revolutionary matter in the curd of milk, and especially when the milk has been produced from cows kept under conditions unfavourable for their general health. The curd is a powerful body, and one easily acted upon by any irritating matter. If you introduce any elements of discord, it becomes very difficult of control afterwards. I well remember Dr. Thomson pointing out the great importance of having the 'vells' well prepared—preferably by dry-salting—and then hanging them so as to let the air have plenty of time and opportunity for acting upon any rank animal matter they may contain. It may be as well for me to say that Dr. Thomson expressed himself to us as to the influence of imperfectly ripened food as another cause of trouble in dairy work. If you get a cold and wet season in which there is a growth of poor quality—which never ripens perfectly under the sun's rays—you may expect additional trouble in consequence. This is again aggravated by letting the cheese-room vary too much in temperature."

"I think," said Mrs. Forbes, "my experience supports what you say, Jack, for we always have most trouble from cold and wet seasons."

"I know," said Mr. Forbes, "that in such seasons my sales never amount to as much as they do in warmer seasons."

"When I come back from Scotland, Mrs. Forbes," said Jack, "I may be able to tell you more about dairying than I know now. If you have any difficulty to get over whilst I am there, let me know, and I will aid you if I can."

The young men having taken their farewell, drove round by the

Forest Farm, to see Tom Hughes, who had just returned from Rodney College, to learn from him the latest news. He had got through his work satisfactorily, and received his Science Certificate. Nothing, therefore, stood in the way of William Ellis succeeding to the scholarship he had held. All was going happily at Rodney College. Professor Nicholson was a general favourite, and the work had gone on most satisfactorily since the weak link in the College arrangements had been rectified. The work in original research had proved to be very successful, and they had laid the foundation for more extended usefulness by means of an Agricultural Chemistry Association. There were several farm stations fixed upon for experiments, all organised and regulated by a central committee, meeting at Rodney College, and consisting of some of the farmers of the district and the entire staff of professors. Jack and Webster were delighted with the report they received, and would have lingered longer, but they were going on to Wrexborough, to see Dr. Whichcord and Mr. Hastings, so they hastened away.

They failed to see Dr. Whichcord, but they saw Mr. Hastings, and from him they heard that the lending library for the science classes was now fully arranged, with the fund given for that purpose, and that Miss Ellen Temple was shortly going to Belgravia College, London, to enter upon her higher instruction in science. There was considerable doubt on the minds of the committee how they were to manage next winter, for there was every reason to expect a very considerable increase of pupils for the science classes. Jack reminded him that Tom Hughes had now returned, and would probably help, and that there could be no difficulty respecting the class for physical science now that it had been so successfully commenced.

The departure of Jack and Webster from the Holt Farm was a source of much regret to many, and very sincere hopes were expressed that after another year both would come back and settle in that neighbourhood. Jack's return to the Holt was very natu-

rally looked forward to, but Webster thought he should in any case like to see something of the world before he settled down. After that was done, it was probable he would take a good farm, and have his mother and sisters near him. Amidst many hearty good wishes they travelled northwards again, and entered upon their respective duties after a short stay in Edinburgh.

Jack's reputation had preceded him, for Mr. Tait, like a prudent man, wished to be well informed respecting the gentleman he was about to receive, and had supplemented the information sent to him by special inquiries of his own. The result of this inquiry was, of course, highly satisfactory, and it had its indirect advantages, for it led to many pleasing associations amongst intelligent neighbours of Mr. Tait. One of the earliest and most agreeable acquaintances he met was a Mr. Walrond, who occupied an adjoining farm, and who was giving his special attention to the growth of seed corn of high character. A more congenial associate he could scarcely have desired, and it was rendered the more pleasing because each had made attainments differing in character, but of mutual interest.

Jack entered zealously into the work proceeding upon Mr. Tait's farm, and took just those branches of work in which he felt himself most in want of information. He found Mr. Tait a man of sound practical experience, which he was always pleased to communicate to one who, like Jack, was really thirsting for knowledge, and who possessed an intelligent mind capable of appreciating valuable information. Fortunately for Jack, he had acquired the valuable habit of avoiding any parade of his own knowledge, and was always ready to learn from any one who had sound information to impart. This habit had been the more thoroughly engrafted into his character by his college course of study, which had taught him that however much he might know, the better was his opportunity for realising the vast extent of knowledge to which he had not attained. It had also shown him that the poorest labourer might have learnt some practical

truth which he had not yet gathered. This made him by settled habit a searcher after knowledge, with much diffidence as to his own attainments. In short, his science training had given him a thirst for knowledge, and good judgment for separating the kernel of truth from the surrounding chaff, wherever it was to be found.

There were frequent interchanges of visits between Jack and Webster, and this increased their opportunities for learning the local practice of agriculture. Scarcely had they got well settled into their regular routine of work when Jack received a letter from his father informing him of the death of his uncle—who had been farming in Lincolnshire—and as the property came to his mother, he had the offer of going down to the farm he had occupied, and taking to the tenancy and stock. This was a bit of good luck he had not expected, but before giving his decision he informed Mr. Woodford of the circumstance, and at the same time expressed his own preference for becoming one of his tenants if an opportunity were likely to arise. After a few days delay he received a letter from Mr. Thompson informing him that old Mr. Foster had decided to give up the Abbotts, and that the Squire thought the farm would suit him. Mr. Holmes fully agreed with Jack in thinking that this would be much better for him than to take to the farm recently held by his uncle. It was therefore arranged that Mr. Holmes should adopt the necessary measures for disposing of the property, holding the proceeds for Jack's use at the Abbotts.

Important as these circumstances were in reference to Jack's future, it caused no interruption in work with Mr. Tait; for the days of mourning being ended, he pursued with steady industry his attainment of a knowledge of the farming operations there carried out. Many an interesting discussion did Jack enjoy with Mr. Walrond, for although the views of the latter were not distinguished by scientific accuracy, they led to such satisfactory results, in increasing the productive power of the seed and in improving the quality of the produce, that Jack saw there was much truth in

them. Mr. Walrond was fully aware of the loss he suffered by want of science, so he practically became a pupil of Jack's, and worked hard at his studies. He saw Jack could thus aid him, and he gladly embraced the opportunity. It was far from being a one-sided bargain, for it was a splendid chance for Jack preparing himself for carrying out the same kind of work himself. It was easy to see that Mr. Walrond did not want any of his neighbours to follow his example, but the position of matters was very different with Jack, especially as he saw that through his assistance at the Abbotts he was likely to secure what he had already found the want of, viz., facilities for getting a change of seed, without loss of purity or excellence. So strongly did this impress itself upon Mr. Walrond's mind that he ultimately recommended Jack to prepare for such work. It was consequently arranged between them that as soon as Jack was ready they would act in concert, more especially as the best markets for their produce would be different, and the profits were decidedly greater than growing all their corn for the miller or for stock.

It would carry us far beyond our limits to notice in detail the many interesting incidents connected with Jack being a "Farm Pupil" under the care of Mr. Tait. It may be sufficient for us to note that when Jack finished his year with Mr. Tait, he felt perfectly satisfied that Scotch farmers fully deserved the popular reputation of being sound and prudent calculators, and that in their daily practice they showed that they knew as well as any men how to farm successfully under conditions of difficulty.

CHAPTER XXX.

WELL REWARDED.

THE time was fast approaching for Jack and Webster to proceed to Rodney College for the examination in the practice of agriculture. They met in Edinburgh for a week previous to the appointed time, and each did his best for two hours on each day to puzzle the other as to what he should do under certain practical contingencies. The duel was fairly maintained, Jack having somewhat the advantage. The examination was held during the vacation, so that the examiners and candidates might be properly entertained in the College. As far as possible the candidates got the temporary occupation of their old rooms, which tended to revive old and pleasing memories, and this happened to be the case with Jack and Webster.

"I wonder who will be the Examiners," said Webster.

"I don't know," replied Jack, "but one thing I will guarantee —viz., that the Principal has taken care that they are men who have themselves travelled over the course they are going to try us upon, and who are also intelligent men, understanding the why and the wherefore of the variations arising in farm practice. Very likely they will be some of the older members of the College, who have passed the same ordeal and become experienced men."

"I am very glad," said Webster, "there is no science examination to interfere with us, for we forget ever so much we are expected to know for such a purpose."

"I dare say," said Jack, "it would puzzle you now to give the combining equivalents of the various constituents of our fertilisers,

and yet you know much more than you did of their mode of action, even when fresh from lectures."

"That is just what I feel," replied Webster. "Everyday duty on a farm rubs off the gilt, but I believe it gives you a foundation of gold in its place, and that is why if they examine one long enough I have no fear of passing, because I know I can give them good practical replies, at any rate for those systems of farming which I have been following."

"A good general knowledge of the cultivation of the land varying according to change of soil and climate is required of all, I believe," said Jack. "You will then be examined very thoroughly upon the systems of farming you have learnt, and if you have made a special study of any particular branch you may go in for that, and it will help towards your Diploma. First of all you have to clear one fence, and then the others, but only one at a time."

The Principal and Examiners dined in the hall that evening with the candidates, and all subsequently adjourned to the college library, for the better opportunity of social intercourse. It was a happy regathering of old friends, and it was in consequence a cheerful and agreeable evening. Dr. Thomson acknowledged that he was proud of this annual gathering in of the ripening fruit, and, in fact, he looked upon it as the College Harvest Home. In these men he saw the result of much anxious care and judicious training, and who can be surprised at his fulness of satisfaction as he saw evidences of the good work the students had done in Rodney College and since they had left its walls? The other members of the professional staff were away for the vacation, and, indeed, Dr. Thomson had but just come back from Normandy to meet them, to dispense the College Honours and add some more good names to those already registered on the College roll. Before he left he had the satisfaction of presenting to John Holmes, Charles Webster, and several others, their respective Diplomas. He most heartily welcomed them as members of Rodney College,

expressing his sincere hope that they would all co-operate cordially with the College authorities in the future, and labour with them as members of one brotherhood for the promotion of agriculture.

With feelings of mutual esteem they took their leave of the Principal, and travelled together as far as Edinburgh, where they received hearty congratulations from Mrs. Webster and her daughters. With all their joy, there was evidently a shadow resting upon the group, for Jack and Webster had become so associated in their work that it was really painful to them now to steer away from each other upon widely different tracks. Jack was about to return to the Holt farm until the following Lady-day, when he was expecting to enter as tenant of the Abbotts farm. Webster had arranged to leave in a few weeks for a visit to New Zealand, thinking he might possibly like the colony sufficiently well to settle there, and find more remunerative employment for his capital than he could expect in Great Britain. It had been a long and intimate friendship, blending their lives almost as brothers, but for the future it could only be maintained by correspondence, and with these feelings of sorrow they bid each other adieu. The feelings of regret were not limited to the two young men, for although Jack had always recognised certain definite limits in his friendship with the family, his repeated visits had really made him one of the circle, and the anticipated cessation of his visits was regretted by all, whilst it was a source of deep but silent grief, to one of them.

Jack's return to the Holt as a fully certified Member of Rodney College was duly honoured, but he had something else to think of besides the past. He had much to consult with his father respecting the entry upon the Abbotts farm, and although the Squire was pleased to express himself with much favour towards him, it was still the duty of Mr. Thompson to see that the business arrangements were put upon a satisfactory footing. Before Webster sailed for New Zealand he had the satisfaction of hearing from Jack that he had completed the arrangements for taking the

farm from Mr. Woodford; that necessary alterations were to be made to the residence and farm buildings; and that old Mr. Foster was going to give him early possession of the land. Jack concluded his letter by saying: "The trip to New Zealand I have no doubt will do you much good, but I shall expect to see you back, so that I may receive your congratulations at the Abbotts before my second harvest, for a good fellow like you must remain with us." There was a mystery here of which Charlie Webster kept the key to himself, but the hope that the separation would be short, diffused a joy at his home which greatly soothed the parting farewell.

Shortly after this, some strictly private communications passed between Jack and Mrs. Webster. He was once again invited to spend Christmas in Edinburgh, and ere that visit ended it had been arranged that Janet Webster should be his future bride; in fact, as soon as the Abbotts was ready for her reception.

The Squire and Mrs. Woodford knew of the result of Jack's visit to Edinburgh some days before his return to the Holt, and the result was that during his absence they met Mr. Thompson at the Abbotts, and some little additions were made to the proposed alterations—the general result being calculated to render the Abbotts one of the prettiest little residences in the neighbourhood. The repairs and alterations of the premises progressed under Mr. Thompson's directions with little or no interference on Jack's part, whilst he—aided by his father's judicious counsel—was devoting his chief attention to the farm. Much had to be done to get the land in proper order, but the entrance upon the stubbles in the early autumn saved a great amount of labour, and greatly aided in altering the condition of the farm. The general appearance of affairs showed that after harvest all would be ready for the reception of the bride, and a short visit paid by Mrs. Webster and Janet to the Holt farm confirmed the decision.

"Before we leave," said Mrs. Webster to Jack, "let me tell you how pleased I am with your thoroughly honourable course of

procedure in reference to your wedding. I know you wish to furnish your house nicely for my daughter's reception, but I also know how important it is that the farm should not be crippled by luxuries in the dwelling. Apart from the settlement which will be made upon her prior to her marriage, she has quite enough to prevent you being at any cost for furnishing, and you need not draw upon your capital for household expenses, at any rate, for the first year after wedding. You can therefore take counsel together, and make your arrangements accordingly."

The autumn was far advanced when Mr. and Mrs. Holmes were at the Abbotts awaiting the arrival of their son and his bride. They were delighted at the happy home their son was likely to enjoy, and the good farm of which he had become the tenant. From what they had seen of Miss Janet Webster they knew that she was perfectly familiar with domestic duties, and possessed an intelligent mind; in fact, they thought she put to shame many girls in their own class, who pride themselves on their ignorance of, and incapacity for, their duties in life. They had not long to contemplate the happy circumstances of the day; for Jack and his wife were seen approaching, and with a hearty welcome they were received into their home. It would be difficult to imagine a happier group, and greatly did they enjoy this their first family gathering at the Abbotts.

"I often think," said Jack to his father, "of the importance of your consent when I first asked you to let me go to Mr. Nicholson's lectures, and you thought I should soon be tired of it. To me it appears as if I had then gone on the path of life to a point where the road divided, and I had the choice of taking an easy down-hill road—leading I know not whither—or of climbing the steeper path I saw before me. I was led to choose the latter, and well do I remember my walks into Wrexborough during the first winter. It was the commencement of the steep path I had chosen; still, in passing on, I have had many pleasant resting

places which well repaid me for all my labour, but none one-half so full of joy as this."

"I suppose, Jack," said Holmes, "you will now consider your Education as completed?"

"So far from that being the case," said Jack, "I hope that as time rolls by I may, in company with my dear wife, learn many fresh lessons of truth, happy in the consciousness of our daily duties being performed with due consideration for the good of others."

THE END.

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